N.R.C
RESEARCH NEWS.
1963 – 65
VOL 16 to 18

- 1. JUL. 1963
LIBRARY

NRC RESEARCH NEWS

Vol. 16 ISSUED BY THE PUBLIC RELATIONS OFFICE NATIONAL RESEARCH COUNCIL OF CANADA Spring Issue

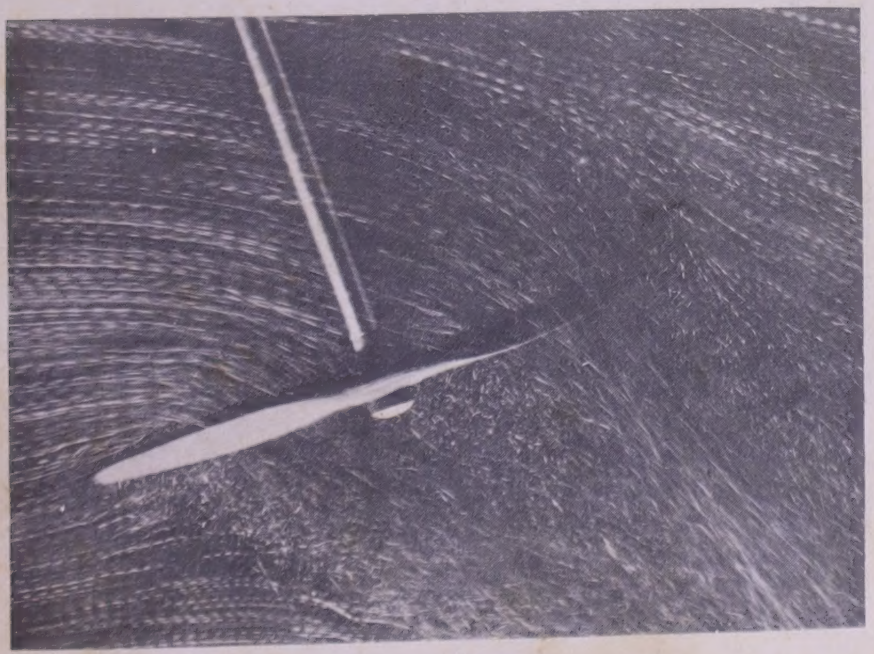
Editor: John R. Kohr Ottawa, 1963. Assoc. Editor: Joan Powers

CFTR1
1+C

FLOW VISUALIZATION IN WATER TUNNEL

The highly complicated flow around inclined propellers, such as would be found in some proposed VTOL aircraft, has been made visible in the water tunnel of the low speed aerodynamics laboratory of NRC's National Aeronautical Establishment.

Photo below shows how the external flow is deflected around such a propeller. With water as the working medium, flow can be visualized by admitting particles of metallic dust or filaments of coloured water, illuminated by a slit of light of high intensity. The light, flickering with twice the frequency of the 60-cycle power line, produces the dotted appearance of the flow; since the time interval between each dot is therefore known to be a hundred-and-twentieth of a second, fluid velocity can be measured at specified positions in the photograph.



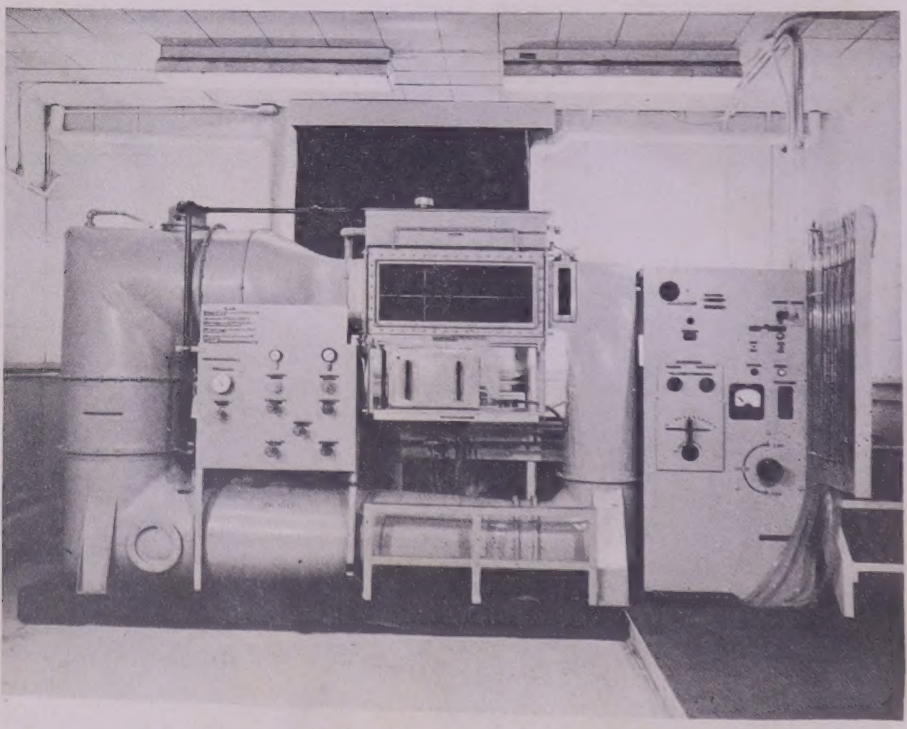
FLOW VISUALIZATION IN WATER TUNNEL - Cont'd

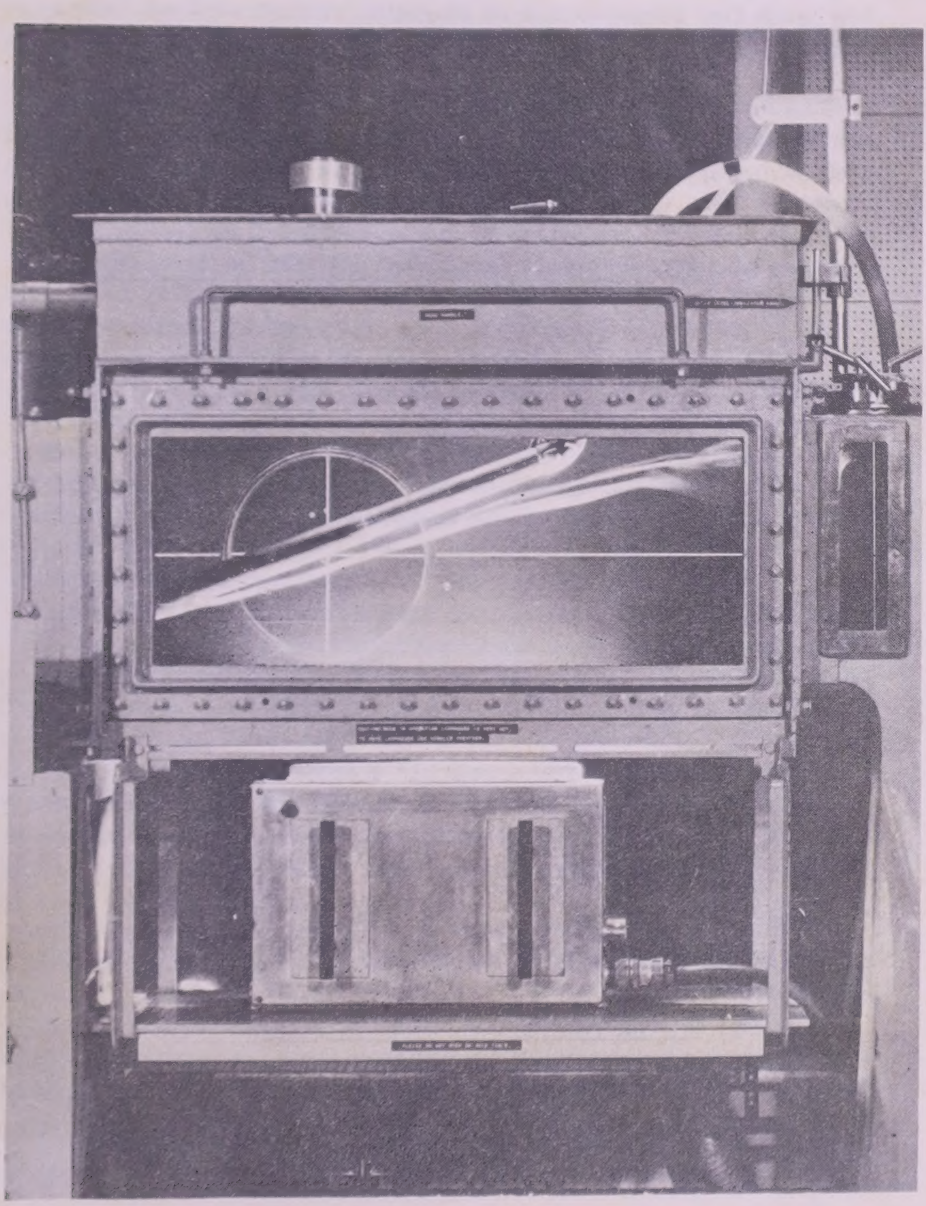
The flow visualization water tunnel serves essentially a triple purpose:

In the first place, it is a powerful tool aiding in the study of many basic research and engineering problems, for instance the flow around bridge structures, mountain ranges, and aerofoils with boundary layer control.

Secondly, it is extensively employed by industry as for example in the development of a gas turbine combustion chamber of a Canadian-designed power plant.

Finally, it is an effective visual aid in presenting the many aspects of fluid flow to those unfamiliar with fluid mechanics.





Close-up of Working Section in Operation

BOOK NOTES

QUANTUM THEORY OF SCATTERING by TA-YOU WU, Head, NRC's theoretical physics section, Division of Pure Physics, and TAKASHI OHMURA, a former NRC Post-doctorate Fellow now with the Department of Physics, University of Tokyo, Japan.

The authors' treatment of the subject in its theoretical aspects and its application to the fields of physics, chemistry and astrophysics, is virtually encyclopedic. Published by Prentice-Hall, 1962, pp. 245, the volume is the first of a proposed series of publications on a world-wide distribution basis, to be known as the Prentice-Hall International Series in Physics.

A BIBLIOGRAPHY OF CANADIAN CLIMATE 1762-1957, compiled by Morley K. Thomas, 114 p., price $1.00. This joint publication of the Meteorological Branch, Department of Transport and NRC's Division of Building Research, contains 1400 items up to 1958; a subject and author index; and a listing of periodicals in which Canadian weather observations are published regularly.

PIERRE BOUGUER'S OPTICAL TREATISE ON THE GRADATION OF LIGHT, translated, with introduction and notes by W. E. KNOWLES MIDDLETON, published by the University of Toronto Press, pp. 248.

This translation of a scientific treatise was made on the occasion of the 200th anniversary of the publication of the original. Dr. Middleton's deft pen sheds new light on the genius that was Bouguer:

"While there is no doubt whatever that he laid the foundations of photometry, most optical scientists are scarcely aware of his existence...

..."The initial achievement of Bouguer was to realize that the eye could be used not as a meter but as a null indicator: that is to say that it is able to establish the equality of brightness of two adjacent surfaces. He then made use of the law of inverse squares first clearly enunciated by Kepler."

The simple and elegant drawings reproduced from the original contribute their part to the enjoyment of this unusual book.

VERSATILE YEAST

A biochemical study of yeasts that had started out with prairie flowers might end up by helping to solve a vexing sewage disposal problem -- how to avoid excessive suds produced by synthetic detergents.

Drs. J. F. T. Spencer, A. P. Tulloch, and P. A. J. Gorin of NRC's Prairie Regional Laboratory give this step-by-step description of their work on "formation of hydroxy fatty acid glycosides by yeast":-

When we first noticed that yeast could be used to make fatty acid glycosides we were actually working on polyhydric alcohol production by yeasts isolated from honeycomb, dried fruit, and wild flowers from the Saskatoon region.

We found that some of the yeasts, when grown in shaken culture, produced an oily, viscous substance that readily settled out of the medium; this substance, of which we were able to prepare only a few grams, turned out to be a mixture of glycoside formed from sophorose (a disaccharide of glucose) and various hydroxy fatty acids.

As the yield was rather small, it looked as though the process would be of academic interest only. Our next idea, then, was to see whether certain yeasts could synthesize the sophoroside from fatty acid esters and glucose. Experimenting with a yeast of the Torulopsis strain, we found that it was indeed able to convert methyl esters of palmitic and oleic acid to their sophorosides and that about 50% of the glucose and up to 90% of the fatty acid esters could be recovered as glycolipid.

We now assumed that this direct utilization of fatty acid esters by the yeast might open the way to large-scale synthesis of a series of long-chain hydroxy fatty acids. We therefore made further experiments which led to the following findings:-

(i) Fatty acids with 16 to 18 carbon atoms were converted directly to hydroxy acids, without degradation or re-synthesis;

(ii) chains longer than 18 carbon atoms were shortened to C-18 chains by loss of two carbon units from the carboxyl end of the chain;

(iii) chains shorter than 16 carbon atoms were not readily incorporated into the glycolipid.

Subsequent experiments revealed that the yeast could convert not only fatty acid esters but also free fatty acids, triglycerides, and long-chain hydrocarbons to hydroxy acids. As long as the chain length was 16 carbon atoms or more, and as long as the melting points of the substrates were not high, conversion to the glycolipid was usually good.

Moreover, we found that the same process could be used to make dihydroxy fatty acids and branched chain hydroxy fatty acids from the appropriate fatty acid esters; but some interference with this conversion process was caused by double bonds and hydroxyl groups that were near the methyl end of the chain; those that were near the centre of the chain did not interfere.

One thing we have not yet been able to do is to isolate the enzymes responsible for the conversion. We have determined that intact, washed cells will form hydroxy fatty acid sophorosides from fatty acid esters and glucose; but we have not yet succeeded in making a cell-free preparation that will do the same thing.

From a theoretical viewpoint, we are working on the suggestion that this hydroxylation of fatty acids depends on two active sites on the enzyme surface. This would mean that

(i) in a fatty acid chain of the "right length" (C-16 to C-18), one of the active sites of the enzyme binds the carboxyl end of the chain while the other binds the methyl end, where hydroxylation then takes place;

(ii) in a chain that is "too long", hydroxylation takes place after the chain is shortened to its "right length" by loss of the appropriate number of two-carbon units from the carboxyl end;

(iii) in a chain that is "too short", no hydroxylation can take place because, after the carboxyl end is connected with one of the active sites on the enzyme surface, the methyl end simply "won't reach" to the active site.

From a practical viewpoint, low-grade fats and some hydrocarbon fractions could be converted to hydroxy fatty acid glycosides serving the double purpose of disposal of these waste products and formation of useful products. The hydroxy fatty acids formed by hydrolysis of the glycoside, which

have a reactive group on each end of the molecule, have possible uses in polymer formation and in the synthesis of macrocyclic rings. Such "tailor-made" chemicals might thus lead to the development of new plastics, fibres, perfume bases, etc. If, on the other hand, the glycoside is left intact and the carboxyl end reduced to a methyl group, then the molecule assumes the typical detergent structure. This detergent, unlike the alkyl benzene sulfonates, would be susceptible to microbial degradation and should not produce the quantities of untreatable suds which now jam many sewage disposal plants and even some parts of our rivers.

HONOURS AND DISTINCTIONS

MR. T. J. BLACHUT, head, photogrammetric research section, NRC's Division of Applied Physics, has been named an Honorary Member of the Brazilian Cartographic Society; the Society also named MR. G. H. SCHUT, of the same section, as a "Member Correspondent".

Mr. Blachut was recently named an Honorary Member of the "Corporation des Arpenteurs-Géometres de la Province de Québec".

DR. D. K. C. MacDONALD, head, low temperature and solid state physics section, Division of Pure Physics, NRC, has been awarded the Gold Medal of the Professional Institute of the Public Service of Canada.

The highest award of the Institute was conferred upon Dr. MacDonald in recognition of his achievement in the field of pure and applied science.

NINTH ANNUAL CONFERENCE ON MUSKEG RESEARCH

"National Implications of Organic Terrain" will be the theme of the Ninth Annual Conference on Muskeg Research to be held at Laval University, Quebec, 21-22 May, 1963. Sponsored by NRC's Associate Committee on Soil and Snow Mechanics, the meeting will deal with topics ranging from fundamental research on peat to engineering problems connected with exploitation of organic terrain for agriculture and forestry.

Anyone interested in attending the Conference, should direct inquiries to Mr. I. C. MacFarlane, Division of Building Research, National Research Council, Ottawa 2, Ont.

"AS I WAS SAYING. . ."

DR. C. J. MACKENZIE, past president of the National Research Council, began a luncheon speech to the Canadian Institute of Surveying, 7 February 1963, by pointing out that the first speech he had made upon becoming acting president of NRC was given twenty-three years ago -- to the same Institute, in the same room, at the same time, on the same day of the month! Here are some excerpts: -

"In my speech to you in 1940 I pointed out that, in 1914, the total annual expenditure for research in this country was less than one-half million dollars. In what now seems a boastful manner I compared that with the situation in 1940 and said that at NRC alone we were actually spending almost $1 million a year (of course at that time a million dollars was something) and the total of all such expenditures by universities, governments and private industry probably would reach the staggering sum of $6 million as compared with the half million of 1914.

"Today the comparable total in dollars is over 50 times larger...

"Private industry has become more research oriented and is spending about $100 millions year', on research and development with the result that there are many sizeable and highly efficient research laboratories, and over 400 individual firms have active research programs. In the federal government sector, compared with NRC staff of 300 in 1940, there are four establishments engaged in industrial and applied research employing 8,000 - 10,000 people and spending over $100 million per year.

"The significant fact, however, is that exactly the same kind of expansion has happened everywhere. For if we plot research and development expenditures we find that for all modern industrial countries the curves representing growth of scientific technology appear to start almost from the base line in 1939 and rise at a rapid geometric rate that shows no signs of levelling off.

"This recent explosive growth of world activity in scientific technology is not just a normal extension - it is a new sort of thing. . .

"Applied science and industry are using today the techniques in mass production that yesterday were thought only possible in research laboratories. . .

"The day of the real application of science is here."

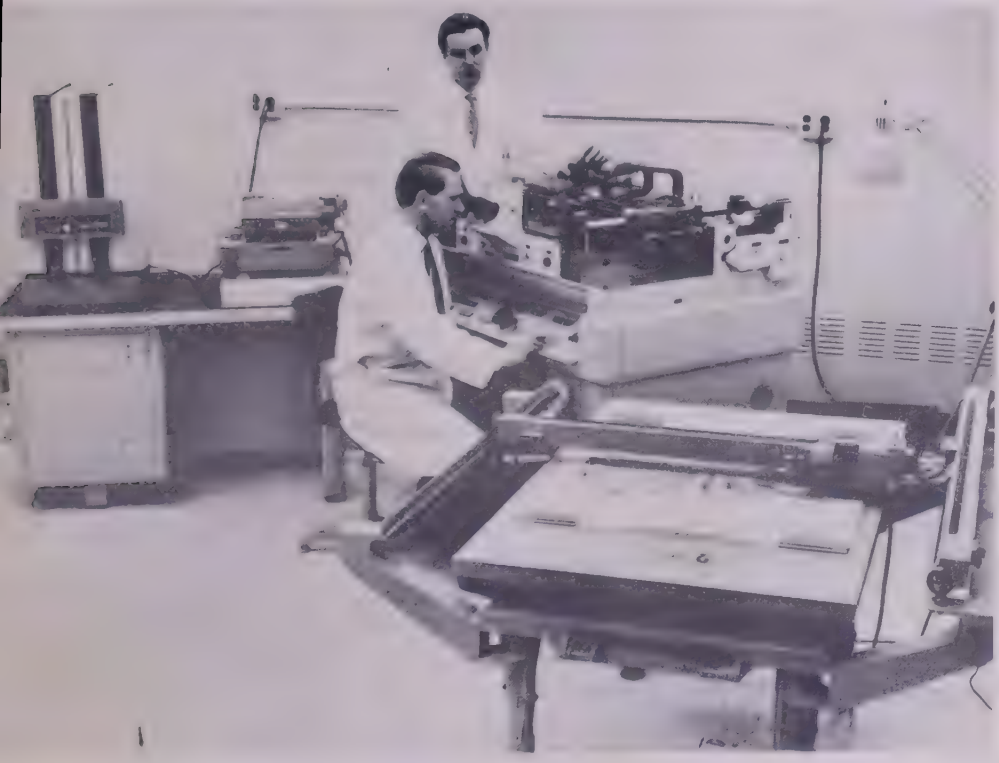
NRC RESEARCH NEWS

ISSUED BY THE PUBLIC RELATIONS OFFICE
NATIONAL RESEARCH COUNCIL OF CANADA

Vol. 16 No. 3

tor John R. Kohr Ottawa, 1963. Assoc. Editor: Joan Powers

ANALYTICAL PLOTTER



MR. U. V. HELAVA (standing) inventor of the Analytical Plotter, discusses this revolutionary instrument with Mr. T. J. Blachut, head of NRC's photogrammetric research section. Use of this versatile instrument, which was the focus of a recent International Photogrammetric Conference, has already produced enormous advances in speed and accuracy of map-making and of measurements from aerial and satellite photographs.

- For story, turn page -

REVOLUTIONARY CANADIAN INVENTION

A new era in the science of map-making, surveying, and even satellite photography may be ushered in by a Canadian invention called the Analytical Plotter.

Invented by U. V. Helava of the photogrammetric research section, NRC's Division of Applied Physics, the Analytical Plotter is expected to make obsolete the massive, costly and cumbersome instruments and the complicated procedures required to convert aerial photographs into accurate maps.

In addition, this revolutionary instrument can be used to plot maps and make measurements where no other plotter could be successfully employed due to distortions and other errors that are impossible to compensate by conventional means. Since such distortions occur, for instance, on weather satellite photographs, the Analytical Plotter will be of special use in space exploration.

The Analytical Plotter substitutes mathematical projection for the mechanical projection on which all other plotters must rely. It consists of three fundamental parts: an optical-mechanical measuring device of greater simplicity that those of plotters now in use: a high-speed electronic computer: and a plotting table.

The electronic "brain" of the plotter can perform up to 40, 000 operations per second. In fact, the new system works so fast, the operator does not even know that the computer is continually helping him: while he is taking measurements of the photographs, the computer automatically introduces corrections for such effects as lens distortion, camera tilt, film shrinkage, air refraction, and even the earth's curvature: it can even compensate for the errors of the measuring instrument itself! In short the operator is able to go ahead with the measurements as if the photographs were completely error-free.

A number of Analytical Plotters, in a very elaborate version of defence purposes, have already been ordered. Several of these instruments have been in operation for over a year and are living up to every expectation.

A much similar version for civilian use is now being produced at prices competitive with traditional plotters of infinitely less versatility. The new equipment is so versatile because it is controlled by a program stored in the "memory" of the computer.

Since this program consists only of numbers, it can be modified or re-used at will. For example, in addition to conventional maps and drawings, the Analytical Plotter can provide precise numerical values of coordinates, distances, directions, areas, volumes and other quantities as requested. These values may be presented in graphical form or they may appear on punched tape ready to be used in further data processing steps.

The impact of the Analytical Plotter may best be judged from the fact that a recent International Photogrammetric Conference in Ottawa, which was attended by industrialists, scientists and engineers from sixteen countries, was devoted exclusively to the Analytical Plotter. So impressed were the experts that a special invitation was extended to Mr. T. J. Blachut, head of NRC's photogrammetric research section, to exhibit the Analytical Plotter and similar Canadian inventions at the Tenth International Photogrammetric Congress to be held next year in Lisbon, Portugal.

The Analytical Plotter is more than a new instrument, it is a new and revolutionary concept that promises to provide a powerful stimulus to the theory as well as the practice of photogrammetry.

HONOURS AND DISTINCTIONS

DR. LEO MARION, Vice-President (Scientific) NRC, received an honorary doctor's degree at the annual spring convocation, University of British Columbia. He also delivered the convocation address.

DR. W. H. COOK, Director, Division of Applied Biology, and President of the Royal Society of Canada received the D. Sc. degree (honoris causa) from Laval University, Quebec, at their convocation exercises held 1 June.

NEW FELLOW OF ROYAL SOCIETY OF CANADA

Twenty-seven distinguished Canadian humanists and scientists have been elected to Fellowship in the Royal Society of Canada.

Among them, DR. S. F. MACDONALD, organic chemistry section, NRC's Division of Pure Chemistry, has been elected a Fellow, Section III (Science).

FOUR NEW DIRECTORS HEADING COUNCIL DIVISIONS

Four new directors are heading the Divisions of Administration and Awards, Radio and Electrical Engineering, NRC's Prairie Regional Laboratory, Saskatoon, and Pure Chemistry.

MR. F. L. W. McKIM, assistant director since 1957 of the Division of Administration and Awards, has been appointed Director of the Division, a position relinquished by Dr. F. T. Rosser, Vice-President (Administration).

DR. D. W. R. McKINLEY, associate director of the Radio and Electrical Engineering Division since 1960, has been appointed Director of the Division, succeeding Dr. B. G. Ballard, recently appointed President of NRC.

DR. H. R. SALLANS, acting director of the Prairie Regional Laboratory since the death in August 1962 of Dr. G. A. Ledingham, has been appointed Director of the Laboratory.

DR. W. G. SCHNEIDER, head, general physical chemistry section, has been appointed Director, Division of Pure Chemistry. Dr. Schneider fills the vacancy created by the appointment of Dr. Leo Marion as Vice-President (Scientific) of the Council.

F. L. W. McKIM
-NRC photo -

D. W. R. McKINLEY

H. R. SALLANS
- NRC photo -

W. G. SCHNEIDER
- Paul Horsdal Ltd. -

NEW MEMBERS APPOINTED TO NRC

Three new members have been appointed to NRC for a three-year term by the Governor General in Council. They are:

PROF. L-P. BONNEAU, Vice-Rector and Professor of Applied Thermodynamics, Laval University, Quebec City;
DR. ROGER GAUDRY Director of Research, Ayerst, McKenna and Harrison Limited, Montreal, Que.; and
DR. R. J. UFFEN, Principal, University College, University of Western Ontario, London, Ont.

These new appointments fill vacancies caused by the retirement from NRC of DR. P. A. GIGUERE, Director of the Chemistry Department, Laval University; DR. L. H. J. SHEBESKI, Professor of Plant Science, University of Manitoba; and DR. F. J. TOOLE, Head of the Department of Chemistry and Vice-President (Academic), University of New Brunswick.

Reappointed to the Council for a further three-year term are DR. P. R. GENDRON, Vice-President of Dow Brewery Limited; DR. PAUL LORRAIN, Head of the Department of Physics, University of Montreal; and DR. J. H. SHIPLEY, Vice-President and Director of Research and Development, Canadian Industries Limited.

L. P. BONNEAU

R. GAUDRY
- Arnott & Rogers Ltd., Montreal -

R. J. UFFEN
- Bill Barrett, London, Ont.

UN CONFERENCE ON THE APPLICATION OF SCIENCE AND TECHNOLOGY FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

Geneva, February 4-20, 1963

Two thousand working papers, eighteen hundred delegates from eighty-six countries, topics concerning the whole field of development from agriculture and human resources to education and transportation! Never before has an attempt been made to bring together in one place all the accumulated experience of scientists and technologists on such a wide front.

This Conference was an important element in the opening stages of the United Nations "Decade of Development". Underdeveloped countries have become increasingly aware of the widening economic gap between themselves and the more industrialized nations. Many countries have gained political independence very recently; in the next decade they expect to achieve economic stability through development of their resources and through industrialization processes which took 50 to 150 years in more advanced countries.

Can they do it? Their delegates had a simple answer: "We must, and we can; but not without assistance far greater than is being offered today."

Dr. J.W.T. Spinks, President of the University of Saskatchewan and a Member of the National Research Council, was leader of the Canadian Delegation. Our Canadian delegates had mixed reactions to the Conference. In areas where technology is well developed and where international programs are well established, the discussions covered old ground. In agriculture, for example, the advanced techniques used in North America are not suited to the problems of developing countries for the most part, but F.A.O. and other agencies have provided the type of assistance required, limited only by available financial and human resources and the ability of the recipient society to change.

Other areas of discussion clearly showed gaps in existing programs. Industrial development, forestry and building techniques have apparently lagged, for many reasons. The United

Nations is now considering how these weaker aspects of international and programs might best be expanded.

Perhaps the most obvious feature of the Conference - its tremendous breadth - was at once its strength and its weakness. Even the largest delegations (the U.S. had 150 delegates, Canada 19) had difficulty giving adequate coverage to all disciplines. Certainly the small delegations of one to three from the least developed countries (some had no delegates at all) could attend only a small fraction of the working sessions and contribute to even fewer.

The one outstanding achievement of the Conference was a result of this same breadth. For the first time a concerted effort has been made to outline in broad terms the development problems of the world in our generation. The result was staggering, even to delegates with long experience in the field of technical assistance. The collected problems of education and social change, of development of industry, natural resources and agriculture, of communication and transportation, and of health and nutrition, brought into sharp focus what remains to be done. For the most part the technology exists, but the resource must be mobilized to ensure its adaptation and application.

The impact of the Conference was evident almost immediately. The U.N., UNESCO and other agencies are moving to broaden and strengthen their activities within the limits of the resources available to them. The effect of the Conference on bi-lateral aid programs will not be apparent for months or even years, but at the very least we may expect a broader outlook and better coordination to result.

Was the Conference a success? One U.S. Senator who attended for a few days as an observer (travelling economy class for the first time) described it in the Senate as "an example of futility and waste". On the other hand, a U.S. Congressman who took part in the discussions said in his report to the House "This Conference can be a first step towards a new era for the development of these nations".

The extent to which the deliberations and conclusions of the Conference are studied and implemented will decide which is right.

- J.M. Roxburgh -

PREPARATION FOR SOLAR ECLIPSE

A total eclipse of the sun will occur on 20 July, 1963, with a path of totality over the northern part of North America. Originating in the North Pacific and passing over Alaska and Northern and Eastern Canada, this path will end in Maine. Since NRC's two radio observatories in Algonquin Provincial Park and at Goth Hill are just south of the path of totality, a small radiotelescope will be constructed with a six-foot parabolic reflector for use at a site where the path of totality crosses the St. Lawrence River.

After the eclipse, the mobile equipment - an improved version of that used at the Algonquin Radio Observatory - will be installed permanently at the Dominion Radio Astrophysical Observatory, White Lake, B.C., where it will be used on solar patrol. This additional patrol in Canada will add three more hours to the world solar patrol at the frequency of 2700 mc/s, thus filling in the longitudinal gap between Ottawa and Nagoya, Japan.

Eclipse observations of the sun are of great value in the observation of many special features of the solar atmosphere. In the past, in 1946 and 1954, NRC's Radio and Electrical Engineering Division made radio solar noise observations of partial solar eclipses which occured at Ottawa. The first of these showed that localized regions associated with sunspots were strongly radio-emissive, and the second revealed that radio emissions from the solar disc was predominantly from the equatorial regions and extended about 10% above the photosphere. It was also found that the radio disc had bright rims at the equatorial regions. The total eclipse in July should provide additional confirmation of these observations, as well as presenting the opportunity to observe some new and as yet unrecognized features. The records will also be of use in analysis of any ionospheric records taken in the path of the eclipse, since it has not been established that the 3000 mc/s solar flux is a recise index of solar X-rays and ultraviolet light. Unlike these extremely short-wave emissions, the 3000 mc/s waves pass readily through the ionosphere. In general, the reduction in the ionization in the earth's upper atmosphere will be associated with the observed reduction in the 3000 mc/s flux. It may be possible to distinguish between the ionizing ability of the emissions from the sunspot regions in contrast with that of the solar disc, though this will depend upon the particular combination of features on the sun's disc on the day of the eclipse.

ERGOT ALKALOID RESEARCH AT PRL

Ergot (from the French for "cock's spur") is a fungus, Claviceps purpurea (from the Latin for "purple cock's spur"), growing mainly on rye, where it infects the spike with grain-sized spur-shaped structures. From the Middle Ages until the first part of the 20th century many epidemic poisonings occurred in parts of Europe as a result of eating bread made from flour contaminated by ergot. The gangrenous type of ergotism started with a burning sensation in the extremities (giving the disease the name of "Holy Fire" or "St. Anthony's Fire"), followed by numbness of limbs, black discoloration and finally mummification and loss of extremities at joints, without bleeding; the convulsive type started with twitching of fingers and toes and progressed to terrible pain, with spells of shrieking and vomiting.

Even before the fungal nature of ergot was known, ergotism became less frequent, mainly because of changing agricultural techniques and social conditions; yet, the fungus is still a threat, since a one-per-cent infection makes grain unfit for food or feed. This fact alone justifies intensive studies of the ergot fungus at NRC's Prairie Regional Laboratory. Another motivation for these studies is the discovery that the fungus contains quite a number of pharmacologically active substances. As early as the 15th century enterprising midwives administered these spur-shaped bodies (whatever they be!) to hasten labour; and some three hundred years later, ergot extract became an official medicant for stimulation of smooth muscle in uterine contraction, for reduction of postpartum haemorrhage, and for treatment of peripheral vascular disorders. Nowadays, the most potent drug in psychiatric research and therapy -- lysergic acid diethylamide, or LSD for short -- is derived from ergot alkaloids. But production of ergot alkaloids on a commercial scale is still dependent on intentionally infecting fields of rye grain with Claviceps purpurea.

By the end of the 19th century investigators started to grow this fungus in the laboratory, because they hoped that it could be made to produce ergot alkaloids without having recourse to the rye plant. For over fifty years, scientists remained baffled by the elusive "something" that made the fungus produce ergot alkaloids "in vivo" (living off the rye plant) but not "in vitro" (being fed in the test tube). After many ingenious (but nevertheless unsuccessful) experiments to simulate the essential host-parasite relationship between the rye plant and the fungus, most scientists were ready to give up. As late as 1956, technical papers stated that in vitro

production was not possible. In 1950, however, this "impossible" goal had been reached by Dr. Matazo Abe of Japan. Interestingly, Dr. Abe's medium and production condition were as simple as could be imagined: the fungus was grown in flasks at 25 C. on a medium consisting of mannitol, ammonium succinate, potassium phosphate, magnesium sulfate and tap water.

We at PRL, influenced by the negative reports from several laboratories in the United States, skeptically attempted to reproduce Dr. Matazo Abe's results. In 1956, we found that they were reproducible. It is now known, after almost a decade of intensive work here and elsewhere, that the fungus will produce alkaloids on many media. The secret of success consists of (i) use of proper fungus strains; (ii) an adequate incubation period; (iii) media allowing a restricted growth; and (iv) purified ether in the extraction procedure so that the alkaloids will not be destroyed during the assay.

Following our confirmation of Dr. Matazo Abe's report we devoted about three years to three objectives: determining the nutritional pattern of the fungus, establishing the parameters of production, and increasing the yields. Our findings showed that (i) there were statistical interactions between certain nutrients; (ii) production was quite sensitive to light, certain anions, salt concentration, and type of growth; (iii) near-optimal production conditions could be established for certain strains; (iv) tryptophane increased the yields although it could not be oxidized by the fungus.

We also established, using radioactive tryptophane, that this compound was the source of the indole ring known to exist in the nucleus of the ergot alkaloids. In reporting this step of "in vitro biogenesis" of the ergot alkaloids, we tied with a group of scientists in Germany, who subsequently were also able to show -- as did others (competition getting remarkably keen!) -- that the remainder of the ergot alkaloid nucleus was built up from mevalonic acid, with methionine or formate providing one methyl group.

Since it is only under very special conditions that Claviceps purpurea produces the ergot alkaloids, they do not appear necessary for growth or function of the organism. Hence their formation may be considered a "shunt" or side path to ordinary metabolism. Between the experimental disciplines concerned with encouraging the production of a "shunt" and those concerned with definition of the biogenetic route to the compounds, there lies a most important but neglected area -- physiology of production. Good production

conditions are usually established by methods that are merely empirical, while biogenesis experiments -- though systematic -- deal merely with the assembly of the substance once the stage has been set; thus, neither discipline answers the valid and essential question: why does a cell produce such a "side" product in the first place?

In biology, the word why generally means: what earlier circumstances caused the phenomenon in question and what survival value does it have? The latter part of the question cannot always be assumed to be answerable; a phenomenon such as the above may be an error in metabolism.

We are PRL are still attempting to answer this ultimate question of why. To date we have only found certain correlations between alkaloid synthesis and other intracellular activities that may give us a clue. For example, we now know that ergot alkaloids are not formed unless (i) accumulation of intracellular lipids, carbohydrates (e. g. trehalose) and similar compounds (e. g. polyols) is curtailed or prevented in the late growth phase; (ii) respiration continues at a constant rate into the late growth phase; (iii) intracellular ribonucleic acid and water-soluble nitrogenous compounds are at a maximum.

Looking back, we can use these findings to explain all the successful production conditions reported in the literature. We can now also define more accurately a "proper" or "high-producing" strain as one having (i) the genetic capacity to form a given nitrogenous shunt product, and (ii) a vigorous shunt metabolism. Armed with such an organism, how can we turn off (or down) carbohydrate and lipid synthesis after growth has taken place, without, at the same time, turning off respiration and production of nitrogenous compounds? The answer lies in presenting the cells with an abundance of nitrogen, while restricting carbohydrate and lipid synthesis by presenting the cells with a poorly utilizable carbon source or by inducing phosphate starvation in other ways. Logical as this interpretation of production may appear, it still remains to be proven. For instance, we still have to determine (i) the precise point where this alkaloid synthesis diverges from the carbohydrate pattern to a predominantly nitrogenous pattern, and (ii) the changes that occur in the synthesis of the actual enzymes involved in this process. At present, we are testing our hypothesis by using not only ergot alkaloids but also penicillin as models of nitrogenous shunt products.

- W. A. Taber -

"REPEAT PERFORMANCE"

For the second year in a row, NRC's Fire Protection Unit has won the C. A. Thomson Challenge Shield, emblematic of the winning entry from a Canadian Government agency in the annual contest sponsored by the National Fire Prevention Association (International).

The N. F. P. A. International Grand Award Plaque, Government Division (for fire protection teams looking after multi-building facilities) also went to NRC. Competing in this Division were 475 teams, both from the United States and Canada.

Headed by MR. G. T. LUKE, the NRC Fire Protection Unit has won major awards every year since it started submitting entries to this competition in 1958.

Photo shows: Dr. F. T. Rosser, Vice-President (Administration), NRC, receiving the awards from the Hon. Donald M. Fleming, then Minister of Justice and passing them on to Mr. J. C. Elliott, Chief, Plant Engineering Service, under whose general supervision NRC's Fire Protection Unit is operating.

- NRC Photo -

LIBRARY

NRC RESEARCH NEWS

ISSUED BY THE PUBLIC RELATIONS OFFICE
NATIONAL RESEARCH COUNCIL OF CANADA

Vol. 16 No. 4

...r: John R. Kohr Assoc. Editor: Joan Powers

WORLD'S FIRST PERFORATED BREAKWATER

The ordinary conception of massive concrete and rock structures required to check wave forces has been completely reversed by the Jarlan Breakwater. Photo above shows part of first full-scale construction, with water spilling back from its openings.

- For story see following pages -

THE JARLAN BREAKWATER

The world's first perforated breakwater, developed by NRC's Division of Mechanical Engineering and built for the Federal Department of Public Works by McNamara Engineering Limited, was officially opened at Baie Comeau, Quebec, in July.

Inventor of the new design, which is literally as well as figuratively a "breakthrough" in breakwater construction, is G. L. E. JARLAN of NRC's Hydraulics Laboratory.

Baie Comeau, located on the north shore of the St. Lawrence River about 250 miles east of Quebec City, has a relatively rugged toporgraphy which makes it almost entirely dependent on water transportation. Such a location is particularly handicapped by the fact that a conventional breakwater under heavy wave action does not permit berthing. The new revolutionary breakwater dissipates the wave energy by a seaward vertical wall that is perforated with three-foot diameter holes and backed by a "wave chamber". The wave-energy entering the chamber is reduced by friction and turbulence; water spilling back out of the holes creates a counter wave which meets the next oncoming wave and reduces its force. The constant filling and emptying of the chamber reduces the wave action, providing a quiet harbour for ships berthed on the opposite side of the structure.

Another advantage of the Jarlan breakwater is that its deck can be used for cargo handling. Decks of conventional breakwaters are often awash, since vertical run-up may reach twice the wave height; the new type of breakwater reduces this run-up by almost 80%, which eliminates the "overtopping" hazard (except in very severe storms).

The building structures section of NRC's Division of Building Research is observing the behaviour of the new structure by carrying out measurements of the strains occurring inside the perforated wall, which will provide information on the level and distribution of maximum stresses under wave action.

The design is being patented by Canadian Patents and Development Limited, a subsidiary of NRC, handling licensing of inventions for Government departments, Canadian universities and provincial research councils. Patents have been granted in Great Britain and France, and are pending in several other countries.

Sea-level view of the novel breakwater at Baie Comeau, Quebec. Its success under heavy wave attack is proving most encouraging.

Aerial view of perforated breakwater. The structure is 1,000 feet long and 60 feet wide.

NRC ASSISTS AIRCRAFT INDUSTRY

Since 1957, NRC's Division of Mechanical Engineering and the National Aeronautical Establishment have been looking at various problems related to VTOL operation and now have a vigorous research program under way. In this program NAE is examining tilting wing proposals involving the use of various high lift devices such as suction and blown flaps, as well as static thrust transformers in the form of ejectors. Analytical and experimental work is also being done on the aerodynamic performance of wings plus buried lifting fans.

The Division of Mechanical Engineering has been studying various engine and fan combinations as thrust transformers, concentrating largely on the thermodynamics analysis of suitable power cycles and the study of critical components and their arrangements.

To permit the examination of problems related to the performance and control encountered during a VTOL take-off and transition at a realistic Reynolds number, a new propulsion tunnel has been constructed by the Division of Mechanical Engineering and is now coming into operation.

The working section measures 10 ft. x 20 ft. x 40 ft. with floor height and porosity adjustable to permit simulation of some of the ground effects. A 1,000 h. p. Ward Leonard electric drive has been installed and will produce a tunnel air velocity of approximately 130 ft./sec. Provisions have been made to install an 8,000 h. p. turbine drive and thereby increase the maximum tunnel velocity to 270 ft./sec.

Of particular interest is the installation of the 16 fan blades, each of which weighed nearly 400 pounds. In order to maintain proper stress distribution under the "hold down" bolts, it was necessary to preload some of the main tie bolts hydraulically. The arrangement is such that the maximum static load on the wood is approximately 900 p. s. i. and under dynamic conditions increases to not more than 1200 p. s. i. Rotor balancing was done *in situ* and is now satisfactory for full speed operation (186 r. p. m.), though further slight adjustment may be necessary after some few weeks of operation.

Tests on a 1/12-scale model suggest the velocity profiles in the working section will be uniform to better than 2% and it is hoped a turbulence level of 1. 1% will be achieved. Auxiliary services include balances (to measure lift, drag and pitching moment), manometers and pressure recordings.

A significant feature of the installation is a compressed air supply up to 32 lb. / sec. at 7 atmospheres, or suction capacity up to 800 cfs at 0. 1 atmosphere, either of which can be connected to the model through piping normally used to support the model on the balance. This air is being used to power the models of propulsion systems under study.

ASSOCIATE COMMITTEE NEWS

For many years NRC's system of Associate Committees has been operating effectively as a coordinating mechanism in the field of Canadian science. To bring to the attention of our readers the unheralded role of the Committees in promoting scientific and industrial research in Canada, we plan to present, from time to time, brief articles prepared by officers of the Committees.

Canadian Committee on Culture Collections and Taxonomy of Microorganisms

Microorganisms -- bacteria, molds and yeasts -- are of vital interest to man. Whole industries are based on the use of microbes, for example: antibiotics are produced by fungi and bacteria: brewing, distilling and wine-making industries are based on the activities of yeasts: bacteria and fungi are important in the manufacture of cheese and other foods. Likewise, the prevention of spoilage due to the action of microorganisms is of great agricultural and industrial importance. And, of course, infectious diseases of plants, animals and man are caused by microorganisms.

Collections of cultures of microorganisms are required

(i) by industries to service as the source of supply for the organisms used daily in fermentation processes or in performing specific tasks;

(ii) in medicine as reference material for comparison with newly isolated strains of infectious agents;

(iii) as sources of living material for use in fundamental research.

Thus microorganisms must be maintained in pure culture for long periods. However, they must not only remain viable, they must also retain their desired properties. These requirements are often difficult to meet, especially in large collections which maintain thousands of different organisms.

The Canadian Committee on Culture Collections and Taxonomy of Microorganisms was established in 1946 in the realization that culture collections occupy a cental position in the field of microbiology and that there was a need for a coordinating body.

The Committee's most recent operation was to sponsor and organize the Specialists' Conference on Culture Collections. This international conference, held at NRC, Ottawa, on 27-28 August, 1962, brought together leaders in the field of preservation of microorganisms. A total of 226 delegates from 25 countries attended. Industrial research laboratories were well represented as were government agencies and universities.

The discussions included the organization of culture collections, their role in science and industry and the fundamental and technical aspects of the preservation of cultures. Special emphasis was placed on the maintenance of physiological, morphological and genetic characteristics. The Conference was the first in this field which attempted so broad a program on an international scale. The proceedings have been published under the title Culture Collections: Perspectives and Problems. (University of Toronto Press; 1963; pp. 221; illustr.; $8.00)

The Committee is also investigating the feasibility of a National Data Centre using modern computing techniques. One of the benefits will be a more efficient cooperation with the International Centre for Information on and Distribution of Type-Cultures at Lausanne, Switzerland.

- S.M. Martin -

HONOURS AND DISTINCTIONS

DR. B.G. BALLARD, O.B.E., B.Sc., D.Sc., F.I.E.E.E., M.E.I.C. (Hon.), President of NRC, has been elected a Fellow Unattached of the Royal Society of Canada. Dr. Ballard is the twelfth Canadian to be so honoured since the Society began electing Unattached Fellows in 1934.

DR. R.F. LEGGET, Director of NRC's Division of Building Research received an honorary D.Sc. degree from the University of Waterloo, and delivered the convocation address on "A Sense of History", at the commencement exercises, held July 6.

DR. C.J. MACKENZIE, past president of NRC and a Member of Council, was awarded the Montreal Medal of the Chemical Institute of Canada at the Institute's June Meeting. The Medal is presented as a mark of honour and distinction to a resident of Canada who has shown significant leadership or has made an outstanding contribution to the profession of chemistry or chemical engineering in Canada.

Dr. Mackenzie was also recently named a Member of the Canada Council.

DR. LÉO MARION, Vice-President (Scientific) NRC, was elected President of the Organic Chemistry Division of the International Union of Pure and Applied Chemistry (IUPAC) at their London Conference in July.

DR. J.A. MORRISON, head of the surface chemistry and low temperature calorimetry section, Division of Pure Chemistry, has been appointed Editor of the Canadian Journal of Chemistry, succeeding Dr. Léo Marion, Vice-President (Scientific) of NRC, who continues as Editor - in - Chief of the six Canadian Journals of Research.

MR. P.J. POCOCK of the aerodynamics section, National Aeronautical Establishment, has been named to the nominating committee of PHOTOGRAPHY 63, an international exhibition of photography co-sponsored by the New York State Exposition and the George Eastman House of Photography. Mr. Pocock has also been requested to hang photographs taken by him in the Invitational Section of the display. The purpose of PHOTOGRAPHY 63 is to acknowledge and encourage work currently being done by a younger generation of photographers.

DR. F. T. ROSSER, Vice-President (Administration) of NRC, has been appointed by the Prime Minister as a Member of the nine-man Committee which is to pave the way for Civil Service Collective bargaining and arbitration. The Committee will examine the need for reforms in existing systems of classification and pay, consult with staff associations and others, and make recommendations to Cabinet.

CHEMICAL HIGHLIGHTS, NRC, 1963

NRC's Division of Applied Chemistry is generating a fresh supply of valuable scientific information for use in exploiting Canada's natural resources and for opening the way for innovations in the chemical industry. Some of the projects lead to practical results with unanticipated applications.

Spherical agglomeration

Spherical agglomeration is a case in point: a short article that appeared in the chemical literature in 1952 was of particular significance because it described an apparently unique phenomenon in the sedimentation of suspensions. This was the mechanical aggregation into dense spheroids of dry barium sulphate in dry benzene. The sedimentation of the spheroids was virtually instantaneous and in contrast to most flocculation phenomena, the settled volume was smaller than that found from free settling of the unaggregated material. If this phenomenon could be made generally applicable its advantages over current forms of flocculation would become obvious.

The subsequent basic study initiated within the Division of Applied Chemistry revealed that while the published description of the phenomenon was erroneous, not only was the aggregation process generally applicable to any suspension when appropriately applied, but it could be made specific to a single constituent in a multi-component system. Moreover, it was found that this "spherical agglomeration" process could be used in the desolvation of highly swollen systems, such as muskeg, and was also useful in eliminating dilute emulsions.

While all of these potentially useful applications have been explored in a preliminary way, the selective granulation of a component or group of components from a system of mixed composition has received special attention. This application presents a number of possibilities for industrial use among which is the upgrading or recovery of mineral values from ore bodies. Here is an example that may be considered as typical although the optimum conditions have yet to be established:

A blend ore sample from a New Brunswick deposit containing about 0.3% of tin, 1% of zinc and minor quantities of other minerals was subjected as a water suspension to simultaneous grinding and aggregation treatment. Derivatives of crude petroleum oil were used to activate the surfaces of the desired mineral constituents and crude oil itself provided the second liquid component required for the aggregation.

This process made it possible to discard 90-95% of the original ore samples as tailings. While a number of controllable variables affected the results significantly, recoveries of 70-90% of virtually all the useful metal values were obtained. The amount of tin and zinc in the concentrate ran as high as nine and 25% respectively. A particular advantage of the process is that difficult-to-treat fines and slimes offer no problem, since the comminution and recovery steps occur simultaneously. Also, the oil used in the aggregation step may be reworked or used as a heat source if this is required for subsequent operations.

Other industrial application possibilities of the spherical agglomeration process are being followed up.

Corrosion Research

Corrosion research is a typical illustration of the constant interplay of fundamental and applied chemistry:

NRC has investigated corrosion problems for over twenty years. At first, the focus was on aqueous systems, such as those found in domestic, civic or industrial water supplies or in cooling systems for internal combustion engines. The chief aim was, of course, to reduce the speed of the corrosion process; this might involve protective coatings, electrochemical methods or chemical inhibitors. While the work of NRC's corrosion laboratory has stimulated interest in chemical inhibitors now in common use, its major contribution consisted in finding out more about the initial chemical reactions that cause corrosion; this knowledge enabled conditions to be established for improved performance from chemical inhibitors.

However, there are two sides to the corrosion story: while, in general, these processes are wasteful - corrosion has been estimated to cost Canadians about $500 million a year - chemical reactions associated with them can also be put to use.

Production of pigments, metal salts, and some magnetic materials is frequently based on corrosion reactions. Extensive fundamental research on corrosion prevention has placed the Division into the vanguard of those ready to "accentuate the positive" side of the corrosion story. Thus we are now entering a new approach to the whole problem, particularly to the primary processes of corrosion.

As well as providing new scientific information, such new knowledge would give us greater control over the rate at which these reactions occur - a matter of considerable economic importance.

Biochemistry

Biochemistry in NRC's Division of Applied Biology permeates almost the entire research program. Most of the investigations have possible applications and influence in a number of widely differing fields, including food processing, dairying, refrigerated transport of foodstuffs, pulp and paper manufacturing, and fibre production. Out of a score of projects, here is an example:

Tenderness is one of the most important quality characteristics of meat. It is at a minimum when muscle is in rigor following slaughter of the animal, but increases progressively with post-rigor storage. The rate of increase in tenderness varies between species of edible animals and fowl, and between individuals of each species; it also varies with certain handling procedures. However, little is known concerning the chemical and biochemical changes that lead to changes in tenderness during post-rigor storage; and development of favourable handling processes by other than trial-and-error methods requires knowledge.

Progress in this field has been limited by lack of sensitive techniques for detecting and identifying minor changes in the muscle proteins. Starch-gel electrophoresis, one of the most critical methods now available for establishing the qualitative composition of a mixture of proteins, is now being applied to a study of the changes accompanying tenderization of chicken breast muscle.

Organic Chemistry

The organic chemistry section of NRC's Division of Pure Chemistry, while studying the constituents of plants with reputed medicinal action, has discovered an alkaloid of a new structural type in a plant used against various diseases by the ancient Incas of Peru. It is noteworthy that the structure of this new alkaloid was deduced with extensive aid of nuclear magnetic reasonance - one of the most modern tools of chemical analysis.

NEW SECTION HEAD

DR. J.S. DUGDALE, senior research officer, low temperature and solid state physics section, Division of Pure Physics, has been appointed head of the section, succeeding the late Dr. D.K.C. MacDonald.

Dr. Dugdale came to NRC in 1951 as a Postdoctorate Fellow from the Claredon Laboratory, Oxford, joining the staff of the low temperature and solid state physics group in 1953. He has published many scientific papers on a variety of topics related generally to thermodynamics and his work is held in high regard in laboratories both here and abroad. Dr. Dugdale is part-time lecturer at Ottawa University, and a Member of the Canadian Association of Physicists.

NEW POSITION

MR. W.C. COLLINS, formerly of the Defence Research Board, has joined the staff of the cosmic rays section, Division of Pure Physics. He will act as Secretary of the Associate Committee on Space Research and of the Canadian Committee on the International Year of the Quiet Sun. The research projects sponsored by these two Committees in branches of geophysics relate largely to the upper atmosphere and by their very nature require both national and international co-operation among participating groups.

Mr. Collins has a broad background in the physics of the ionosphere, aurora, and related problems. He was collaborator in an investigation of radio absorption in polar regions which won international recognition for classification of radio absorption events and explanation of the phenomenon now known as "polar cap absorption".

AS OTHERS SEE IT

In the early days of Canadian entomology most of the research was empirical.... But, although it served reasonably well in its time, empiricism eventually became pretty well played out. It had to be improved upon. Unfortunately, it left an impression that seems to have solidified with time:... basic research was brains and a white laboratory coat; applied research was brawn and greasy overalls.

Some of the proponents of the new frontier in entomological research became far less concerned with the problems of the farmer on the back concession than with the publication of profound-looking fragments of research - with reason; technical articles were the stuff reclassification was made of! ... It's time we discarded the idea that applied research is a haven for mediocrity;... it involves both the publication of articles and the selling of ideas. And selling an idea may prove more difficult than writing about it.

- Extract from article by J. Marshall, Entomology Newsletter, Vol. 41, No. 5 -

IN MEMORIAM

DR. D. K. C. MacDONALD, 43, F.R.S.E., F.R.S.C., F.R.S., one of the world's foremost physicists in the low temperature and solid state field, and an outstanding scientist at NRC, died 28 July, in Ottawa. Dr. MacDonald had been head of the low temperature and solid state physics section Division of Pure Physics, since 1951.

His courage and accomplishments despite a crippling and progressively incapacitating disease (amyotrophic lateral sclerosis) were an inspiration to his friends and colleagues.

He was Honorary Chairman of the Department of Physics, Faculty of Pure and Applied Sciences, Ottawa University, from 1955-60, and was later named Honorary Professor. In 1960 he was appointed a NATO Visiting Professor in Physics at the University of Utrecht, The Netherlands, and the same year was awarded the Gold Medal of the Canadian Association of Physicists. This year the Professional Institute of the Public Service of Canada bestowed upon him their highest honour - the Gold Medal of the Institute in recognition of his contributions to national or world well-being in a field of pure or applied science.

Dr. MacDonald had been active in explaining science to the public. He gave some of the Oxford Christmas Lectures to children and began a similar series at NRC in 1956. He was the producer-director-demonstrator-commentator of a film entitled "An Experiment in Physics", and the author of five books entitled "Near Zero", "Thermoelectricity - An Introduction to the Principles", "Introductory Statistical Mechanics for Physicists", "Noise and Fluctuations: An Introduction" and "Faraday, Maxwell and Kelvin" (in press).

BOOK REVIEW

INTRODUCTORY STATISTICAL MECHANICS FOR PHYSICISTS, by D. K. C. MacDONALD. Published by Wiley, N. Y., 1963.

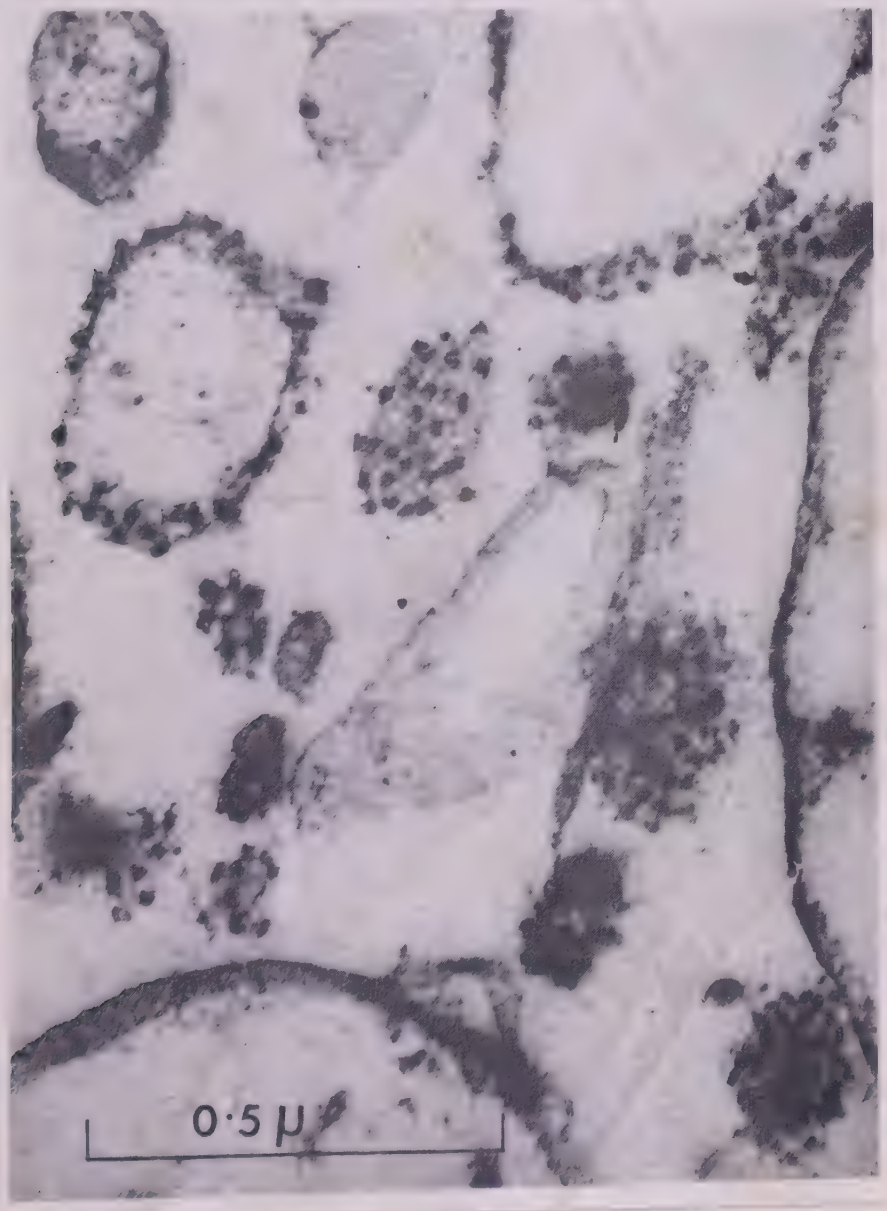
A refreshing informality of style is combined with a relentlessly probing logic to help young physicists overcome "the awe which often seems to surround statistical mechanics". The book is alive with historical footnotes and anecdotes, conveying a certain "feel" for the breadth and power of the subject.

At the same time the principles of statistical mechanics are stated so clearly and are so well illustrated by examples that this "introduction" - a trim 176 pages! - may serve as a valuable companion volume to the classical texts in this field.

NRC

LIBRARY

RESEARCH NEWS



Volume 17

No. 1

Spring 1964

Editor: John R. Kohr

Associate Editor: Joan Powers

Cover:
Cross-section of a suspension of mitochondria. The dark spots are particles on the membranes of the mitochondria.

Photo Credits
Cover
National Research Council

Page 4
Garcia Studio, Montreal
LeRoy Toll, Toronto
Coronet Studio, Montreal
University of Manitoba, Winnipeg

Page 7
Newton, Ottawa
Larry Golch, Edmonton
Bill Barrett, London
National Research Council

Page 8
National Research Council

Page 9
University of British Columbia, Vancouver

Last page
York Studio, Toronto

Energy and How We Get It

Energy (or the lack of it) is as important to biologists as to chemists or physicists, but the carriers of energy in biological systems are fewer, more fragile and more specialized. Most, but not all, of the energy used in living organisms is channeled through adenosine triphosphate (ATP) or, to be more particular, through the terminal bond in the chain of phosphate residues of this compound.

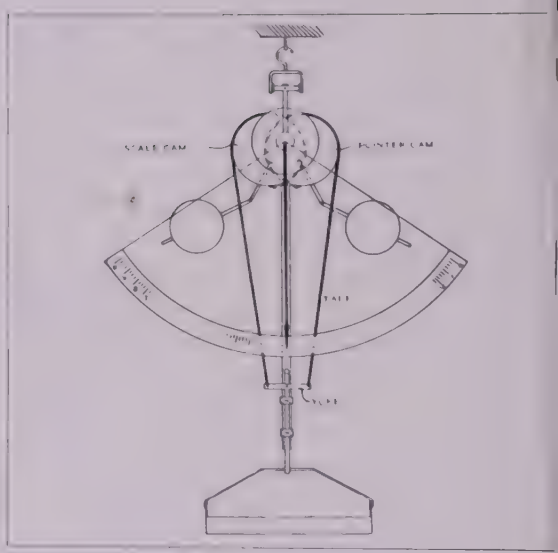
When this bond is split to form adenosine diphosphate (ADP) and inorganic phosphate, the resulting free energy may be used, by a variety of specialized pathways, to "drive" biosynthetic reactions, provide heat, do mechanical work and transport chemical constituents of cells against a concentration gradient.

Five general biological processes are known for generating ATP but, in higher animals, one is overwhelmingly dominant: oxidative phosphorylation linked to electron tranport. In this process, electrons derived from foodstuffs are supplied to a chain of complex oxidation-reduction reactions which ends in molecular oxygen. As an electron passes through the chain, a part of the free energy may be used to generate several molecules of ATP from ADP and inorganic phosphate. The maximum number of molecules of ATP produced, the chemical components of the chain, their arrangement in the chain, and the detailed mechanism of the formation of the "high energy" bond are now subjects of intense study in many laboratories.

For some years the site of this process in cells has been known to be in the mitochondria, small (0.5 x 1 mu) (a mu is a thousandth of a millimetre) particles of various shapes with internal projections called cristae. Recently, fractionation of suspensions of mitochondrial fragments has enabled Prof. D. E. Green and colleagues of the Universtiy of Wisconsin to isolate a reconstituted spherical particle with complete electron transfer properties which Dr. Fernandez-Moran of Chicago has shown to be about 160 Angstrom units (an Angstrom unit is one ten-millionth of a millimetre) in diameter. This size is consistent with biochemical requirements but the particle might have been an artifact of disruption and reconstitution. However, Drs. C. V. Lusena and C. M. S. Dass of the Biophysics Section of NRC's Division of Biosciences have observed directly, in rat liver mitochondria broken by freezing and thawing, a spherical particle of the same size as the reconstituted particle. Corollary biochemical and physical analyses confirmed that the observed particle was involved in electron transport. These particles are distributed along the surface of the membranes of the mitochondria and appear to be an integral part of these partitions.

Correlating the biochemical and physical properties of these preparations with other studies leads one to the tentative conclusion that each of the observed particles contains one and only one complete electron transfer chain, composed of lipids and proteins. Each particle may thus be considered crudely as a minimal assembly line for the conversion of energy derived from the electrons of foodstuffs into the energy stored in the terminal bond of ATP.

A Weighing Scale for Use at Sea



Fisheries scientists needed a precise method for weighing fish on the unstable platform provided by the deck of a research vessel. All existing scales were unsatisfactory when exposed to rolling, pitching, and engine vibration. Mr. Eric Green of the Division of Applied Physics has evolved a relatively simple solution – a combination of two pendulum scales pivoted about a common axis to compensate for the movement of the sea.

This scale, shown here, is of the pendulum type, and uses the conventional eccentric cam and metal tape system. Both the pointer and the graduated scale itself are balanced by a pendulum, so that they both can move relative to the body of the scale and relative to each other. The system behaves, in effect, as if the weight of the object placed in the pan were divided into two portions which were weighed separately and then summed to give the total weight.

If this scale swings about its support, the two pendulum weights take up different positions and the yoke rotates on its pivot to adjust for the changes in tape length. Since the weight reading is relative to both pendulum systems it does not change.

In trials on a ship steaming at 10 knots and pitching slightly every five seconds, this balance was able to weigh a five-pound fish to the nearest hundredth of a pound within five seconds. Even in very rough seas it weighed to the nearest 1/20 of a pound. Other ranges of sensitivity are now being explored.

n Introduction to Radiation Chemistry y J. W. T. Spinks and R. J. Woods. ublished by John Wiley and Sons, Inc. 964.

A comprehensive and up-to-date in-roduction to the whole field of radiation hemistry. This unique book – the first ingle unified text in this field – arose rom a course of lectures given by the uthors, over a period of years, to gra-uate students at the University of Sas-atchewan. The experience of the authors pans 35 years in photochemistry, spec-roscopy, chemical kinetics, radiochemis-y, and radiation chemistry, as these elds were developing. They present a alanced account of experiment, theory nd practical application leading to an nderstanding of the general philosophy f radiation chemistry. The methodology f the subject is clearly stated, and the ndustrial possibilities clearly indicated. is the hope of the authors that the book ay contribute to the widespread use of diation in industry.

Dr. Spinks is President of the Univer-ty of Saskatchewan, and has been a lember of the National Research Coun-l since 1958; Dr. Woods is a former RC Postdoctorate Fellow and is presently ssistant Professor of Chemistry, Uni-rsity of Saskatchewan.

leteor Science and Engineering by . W. R. McKinley. Published by cGraw-Hill Co. Inc.

Dr. McKinley, Director of NRC's Radio nd Electrical Engineering Division, has been associated with the many areas of meteor science and engineering since 1947. This book summarizes the major observational and theoretical developments in meteor science, and embraces the spatial history of meteor particles and the effects they create in the upper atmosphere. It is written not primarily for the communications engineer, but for the scientific layman or even the meteor research specialist, who may not be acquainted with the engineering aspect of meteor research, and for the non-specialist in meteor research who desires some background in the field.

National Fire Code of Canada 1963. NRC No. 7550.

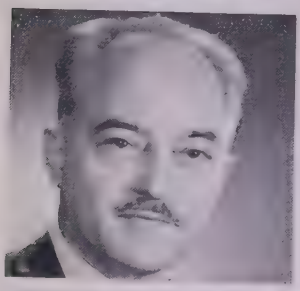
The first edition of the National Fire Code of Canada has now been published by the National Research Council, through its Associate Committee on National Fire Codes.

The Code was developed by a technical committee consisting of prominent individuals in civic and provincial government affairs, and in civic, provincial and federal fire matters, who served voluntarily under the Associate Committee. NRC provided the necessary technical and secretarial assistance.

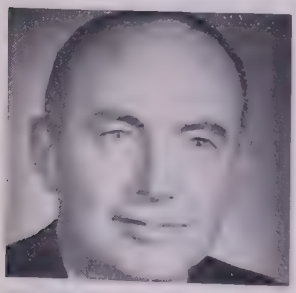
This advisory document is written in the form of a local municipal bylaw, so that it may be easily enacted or adopted by a municipality as a fire prevention bylaw.

New Members of the National Research Council

Dr. W. H. Gauvin, Research Manager, Noranda Research Centre, Pointe Claire, Quebec.



Dr. D. J. LeRoy, Head, Department of Chemistry, University of Toronto, Toronto, Ontario.



Dr. H. Rocke Robertson, Principal, McGill University, Montreal, Quebec.

Dr. H. H. Saunderson, Vice-Chancellor and President, University of Manitoba, Winnipeg, Manitoba.

efrigerated Railway Cars and Trucks

arly Canadian railway refrigerator cars ere copies of their United States counrparts. Late in the 19th century several .S. patents covering methods of cooling ilway cars were issued: the methods roposed varied from an open platform n which ice was placed before loading ne car, to moderately efficient endunker arrangements. This latter type apears to have been introduced into Cada before the turn of the century. To nprove the quality of exported butter nd cheese, the Department of Agriculre arranged with the railways to run frigerator cars over the main lines leadg to Montreal. The Department guarnteed a minimum return for this serve, and it was inaugurated in 1895 and ontinued for many years. Inspection of ese railway cars in Montreal was begun 1900, and temperatures between 49 nd 56°F were reported. A somewhat milar service was arranged by the Fishies Board in September, 1907; iced cars r the transportation of fish were atched to a fast train leaving Halifax on turday of each week.

During the 1920's, interest in the shipent of frozen foods increased, and in 928 the Fisheries Research Board beme concerned about the effect of exosure to undesirably high temperatures uring shipment on the quality of frozen h. Dr. Leim, who was Head of the alifax Technological Station, made a udy of refrigerator car temperatures uring shipment of frozen fish in 1932 d reported temperatures from 18 to °F at the top of the load. Even higher temperatures were reported by others. Obviously these temperatures could contribute to deterioration of the fish, and improved refrigerated transport facilities were needed. A cooperative program was undertaken by Fisheries Research Board and the railways, and NRC joined in this work in 1932.

Winter shipment of unfrozen foods, including canned as well as perishable products, requires insulated, heated railway cars. For economic reasons, it is obvious that the insulated car used for summer refrigeration must be made to serve throughout the year by the addition of a suitable heater.

These two related problems were assigned to the Canadian Committee on Food Preservation, a jointly sponsored Associate Committee formed in 1934 to bring together food scientists and technologists from industry, universities, and three government laboratories (FRB, Agriculture, NRC). Under the aegis of this Committee laboratory work was done at NRC, and cross-Canada shipments of frozen fish and other foods, spiked with thermocouples under the surveillance of Fisheries and NRC staff, were made. For several years, NRC also operated a ¼ length but otherwise full scale railway car, complete with a rocking device to simulate road movement, in a laboratory room in the Sussex Drive building.

This work resulted in the introduction and subsequent improvement of the overhead bunker refrigerated car, which has proved quite superior to the earlier type.

Cooling is provided by filling the overhead bunkers with ice and salt. The position, shape, and construction of the bunkers facilitates convection flow of cooled air down the outer walls of the car and up through dunnage space in the load.

When required, anti-freeze solution is heated by a charcoal or propane burner slung beneath the car and circulated by convection through pipes laid beneath a slatted false floor.

These improved refrigerator cars provided temperatures of 12-15°F with little spatial variation within the car, but those studying the technology and storage life of frozen foods were producing evidence that these foods should be held at or below 0°F. The Committee therefore sponsored continuing technological investigations and these led to the introduction of eutectic ices and of mixed bunker salts to lower the bunker temperature, and to modifications in the construction and position of the overhead bunkers to lessen the difference between bunker and car temperature. As a result of this work, Canadian railways now operate cars capable of maintaining temperatures of 5°F with little spatial variation within the car and without the use of mechanical equipment that would increase maintenance costs and require skilled servicemen at frequent check-points across the country.

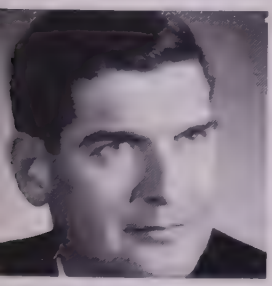
These improvements in the conditions under which foods were transported by rail did not complete the work of the Committee, for road transport of foods had become common practice, and surveys during the 1950's showed that the service provided by many refrigerated trucks was inadequate to preserve the quality of frozen foods. Fortunately, sufficient technical knowledge was now on hand, mainly as a result of NRC studies on refrigerated storages constructed on the jacketed or cold-wall principle, to permit the design of trucks and trailers that would provide greatly superior load temperature control without a corresponding increase in the capacity or cost of the mechanical refrigeration units used. The Committee therefore encouraged study of a mock-up truck under static and under road conditions. This was followed by commercial construction of a trailer to the specified design. Tests on it were so successful that 25 trailers of this type were put into operation hauling frozen foods during the last year.

From the food quality point of view, these improvements in the service offered by a supporting industry are equal in importance to the changes which have occurred in the food industry itself. They reflect the results of prolonged and extensive efforts put forth by many research workers and coordinated by the Committee. However, it is possible to select a few individuals who deserve particular credit. Among these are Mr. O. C. Young, now retired from the Fisheries Research Board, Dr. C. D. Niven, now retired from NRC, and Mr. C. P. Lentz, head of the Food Technology Section, Division of Biosciences, NRC.

Personal Items

Dr. J. S. Dugdale, head, low temperature and solid state physics section, Division of Pure Physics, NRC, has been elected a Fellow of the Royal Society of Canada.

Dr. H. E. Gunning, Professor and Head, Department of Chemistry, University of Alberta, and a Member of the National Research Council, has been elected a Fellow of the Royal Society of Canada.



Dr. R. J. Uffen, Principal, University of Western Ontario, London, Ontario, and a Member of the National Research Council, has been elected a Fellow of the Royal Society of Canada.

Dr. D. R. Whitaker, head, fermentations and enzymology section, Division of Biosciences, NRC, was awarded the D.Sc. degree by London University.

International Award

Mr. U. V. Helava, photogrammetric research section, Division of Applied Physics, NRC, has been presented with The Fairchild Camera and Instrument Corporation Award by the American Society of Photogrammetry.

The purpose of the Award – a silver plaque mounted on a wood panel – is to stimulate the development of the art of aerial photogrammetry in the United States.

Mr. Helava, an M.Eng. from the Finnish Institute of Technology, and a 1953 NRC Postdoctorate Fellow, is the inventor of the Analytical Plotter – a revolutionary new instrument which ushers in a new era in map-making, surveying, and satellite photography.

The Plotter substitutes mathematical projection for the mechanical projection on which all other plotters rely. In addition, the instrument can be used to plot maps and make measurements where no other plotter could be successfully employed due to distortions and other errors that are impossible to compensate by conventional means. Since such distortions occur, for instance, on weather satellite photographs, the Plotter will be of special use in space exploration.

This new and revolutionary concept promises to provide a powerful stimulus to the theory as well as the practice of photogrammetry.

rst Recipient of
eacie Memorial Fellowship

. Neil Bartlett, Associate Professor of emistry, University of British Colum-, has been named first recipient of the tional Research Council's *E. W. R. acie Memorial Fellowship.*

Established by NRC in March 1963, the llowship perpetuates the name of Dr. W. R. Steacie, President of the Coun- from 1952-1962.

Reflecting Dr. Steacie's outlook and nciples, the award is designed to give tstanding and promising young staff mbers of Canadian universities the portunity to spend two or three years uninterrupted research.

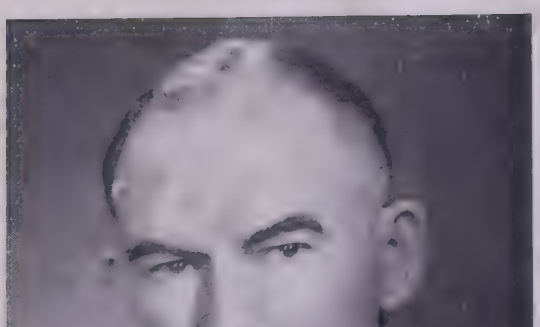
Limited to research in the natural ences, the *E. W. R. Steacie Memorial llowship* has no restriction as to na- nality or citizenship of candidates, but st be held in a Canadian university affiliated research institute), and will rmally be held by a university staff mber at his own university. The Fel- rship is to be held for a period of two rs and may be renewed for an addi- nal year.

Dr. Bartlett, 31, came to Canada from gland in 1958, when he joined the staff he University of British Columbia. He n Associate of the Royal Institute of emistry, a Member of the Chemical titute of Canada, and a Fellow of the emical Society of Great Britain. The nor of 20 scientific papers, he was ned First Noranda Lecturer of the emical Institute of Canada in 1963.

Dr. Bartlett achieved world-wide fame October, 1962, when he prepared the true compound of the rare gas

xenon. By successfully combining xenon with another gas to form a stable chemical compound, a reaction previously regarded as impossible, he not only overthrew a number of existing theories on chemical bonding. but also opened up a new field of scientific investigation. As a result of his work with xenon, the chemistry of the rare gases is now being studied in laboratories the world over.

Industrialist Appointed NRC Vice-President



Dr. K. F. Tupper, O.B.E., 59, has bee appointed Vice-President (Scientific) c the National Research Council.

Dr. Tupper was born in Lynn, Mass in 1905. He obtained the B.A.Sc. degre in mechanics and engineering from th University of Toronto in 1929. The sam year he joined NRC as a research engineer employed in the design of wind tunnel and aeronautical research facilities.

From 1944-1946 he was Chief Engi neer at Turbo Research Limited – a crown company engaged in design an development of aircraft gas turbines.

Dr. Tupper was then named Assistan Director of Research and, subsequently Director of the Engineering Division, a NRC's Atomic Energy Project (now Ato mic Energy of Canada Limited).

In 1949 he returned to the University of Toronto as Dean of Applied Scienc and Engineering.

From 1954 until 1963 he was Presiden of the consulting engineering firm of Ew bank, Tupper and Associates Limited Toronto.

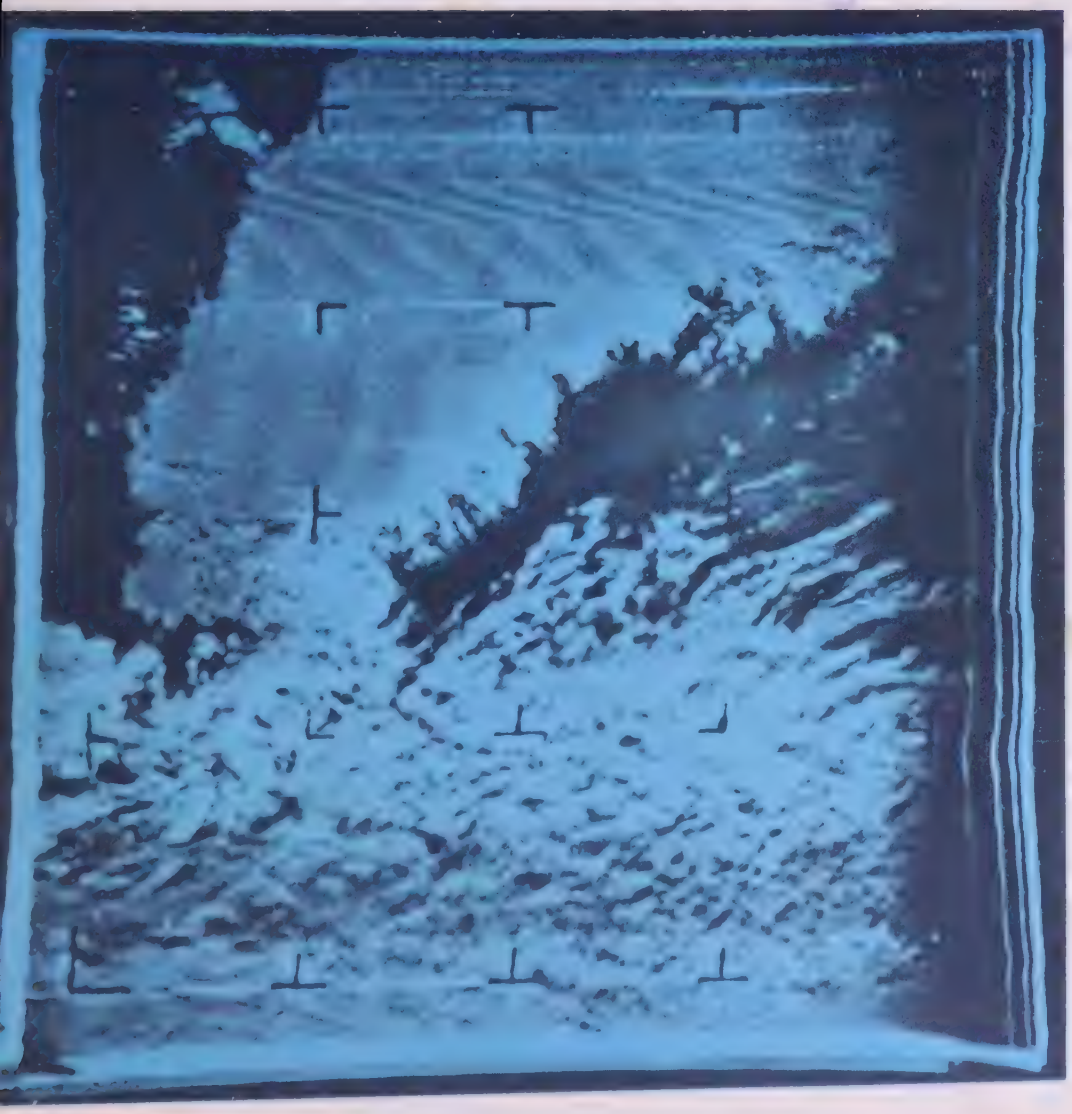
He holds an S.M. degree in aeronauti cal engineering from the University o Michigan, honorary D.SC. degrees fron Laval University and the University o Western Ontario, and the honorary LL.I degree from McMaster University.

Dr. Tupper is an Honorary Membe and Past President of the Engineerin Institute of Canada, and chairman of th Board of Governors of the Ontario Re search Foundation.

NRC

RESEARCH NEWS

19 3-63



Volume 17

No. 2

Winter 1964

Published by the Public Relations Office
National Research Council
Sussex Drive, Ottawa 2

Cover:
APT photograph of clouds south of Greenland's southern tip obtained from the Nimbus satellite via the NAIREC APT unit at Frobisher, 135th orbit, 6 September 1964.

Photo credits:
All photographs by National Research Council except: Page 10 Dr. Ballard by Paul Horsdal, Ottawa
Dr. Marion by Capital Press, Ottawa

rd Hazards to Aircraft

ne problem of bird strikes to aircraft is t new. It probably goes back almost to e beginnings of powered flight. It is en conceivable that the Wright brothers ight have been troubled by birds, since lls and other birds nest in large num-rs along the North Carolina coast.

But in early aircraft the impact was ely to cause limited damage and, prob-ly, the birds had time to dodge. As air-aft speeds have increased, so has the rd strike hazard grown from the status a minor nuisance to a major hazard. ere are examples of severe damage to engines from the accidental intake of ds on the wing.

Although there have been no fatal shes of civilian aircraft known to have en caused in Canada by birds, damage s been caused. It has been estimated t bird collisions have cost Canada's il airline operators up to $1,000,000 the past five years.

Outside Canada, at least two fatal civi-n air crashes and three military crashes ve been directly attributed to bird col-ons. In these crashes 82 people lost ir lives, indicative of the potential nger of birds to aircraft.

Faced with a problem of complexity l seriousness, the deputy minister of nsport requested the National Research uncil to investigate possible solutions. e result was the setting up of the NRC ociate committee on aircraft engine l strikes, later renamed the associate mmittee on bird hazards to aircraft.

Members of this committee are by no means limited to NRC personnel. They are drawn from government and private aeronautical groups, research and operational, and include biologists inside and outside the government service.

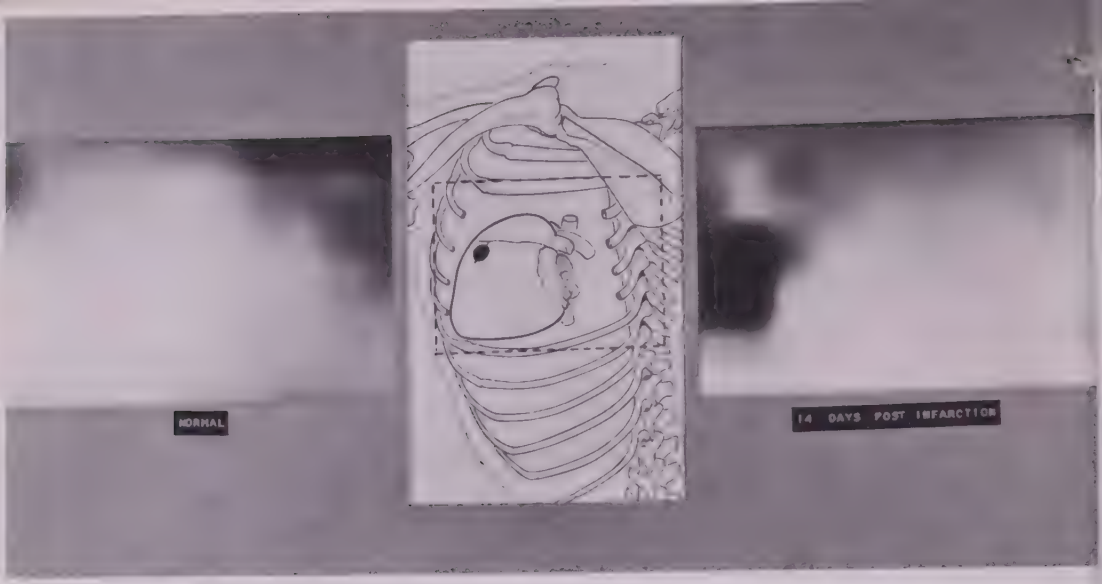
The work of this committee in the past year has included an ecological survey of 30 problem airports across Canada and four RCAF stations in Western Europe. Means of dispersing birds at airports have been studied and put into effect both experimentally and operationally.

Among the methods tried have been the use of falcons at Victoria and HMCS Shearwater, Dartmouth, N.S., airports, as well as fireworks and automatic acetylene exploders at other airports, particularly at Vancouver.

Working toward immunity of aircraft to bird strikes, engine protective screens are being studied.

Work done under contract by the Canadian Wildlife Service is aimed at increasing knowledge of bird movements. Radar is being used in this study. Efforts are also being made to establish a continental radar warning system to detect major migrations of large birds which pose a real hazard to aircraft in flight.

The committee's co-operation with national and international agencies has contributed to having the bird hazard problem brought before the International Civil Aviation Organization for a study so that this worldwide problem may be finally solved on an international basis.



Studies of a dog's heart show at left picture of a normal heart obtained with NRC's new electrocardiograph. At centre is plotted the position of a myocardial infarct and at right the electrocardiograph photo of the same infarct

New Electrocardiographs are Designed

Two new electrocardiographs, designed by the National Research Council, have been under test at Queen's University and were reported at the recent Annual Conference on Engineering in Medicine and Biology at the Case Institute of Technology in Cleveland.

The first machine is an area display electrocardiograph which makes it possible, for the first time, actually to see and photograph the results of a heart attack in a living heart. So far only animal studies have been reported. About 2,000 animal photographs have been made. The area of infarct is revealed in photographs as a dark coloration which can be measured.

The electrocardiograph functions very much like a television station in miniature, Graham Schuler, M.D., told the conference. Some 70 electrodes, placed around the chest pick up electrical signals from the heart and transpose them into signals that can be televised and then photographed.

The machine is now undergoing further tests using a dummy human and a tape recorder to reproduce heart sounds.

This machine, like the second electrocardiograph reported, was developed by Dr. Schuler and O. Z. Roy, electronics engineer, both of NRC's medical electronics group, instruments section, Radio and Electrical Engineering Division.

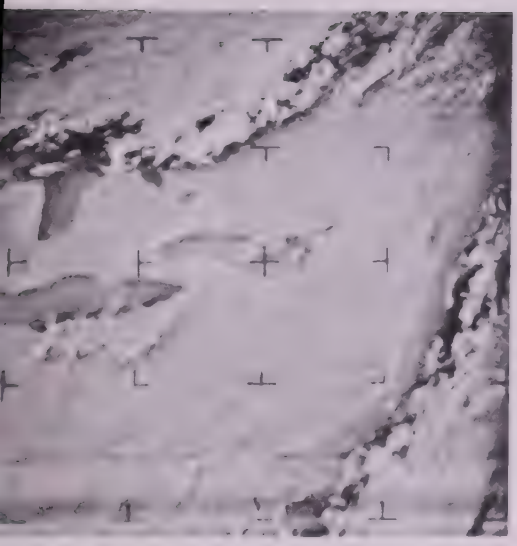
The second electrocardiograph is designed to detect faint fetal heartbeats which otherwise would be masked by the mother's heartbeat or muscular electrical activity, or by external interference.

The machine requires the use of from six to eight electrodes placed around the mother's waist and one in her groin. Signals from these electrodes are manipulated and computed mathematically so that the baby's heartbeat is amplified while undesired electrical noise is reduced.

A baby's heart produces only about 10 one-millionth volts of energy, while the mother's heart alone puts out about 300 times as much electrical energy.

Dr. Schuler said the new fetal electrocardiograph could be useful in: indicating the position in which a baby is lying in the uterus; monitoring the baby's heartbeat during labor; determining the best time for performing Caesarean section or inducing labor in incompatibility conditions; and possibly in testing an unborn baby's heart condition by temporarily lowering the mother's supply of oxygen.

'Nimbus' Satellite Pictures are Excellent



ake Ontario and Lake Erie are easily lentified as is St. Lawrence River. The ttawa River can be seen running north-est from its juncture with St. Lawrence, ppearing just northeast of Lake Cham-ain. Cells of cumulus cloud lie south of oreline of Lake Erie and Delaware and hesapeake Bay. The Delaware and squehanna River show white in tone om sun reflecting on their surfaces. ense vegetation areas show up darker tone than cultivated land and the folds the Appalachian Mts. are delineated different tonal patterns at the lower ntre portion of the photo

Photographs obtained from transmissions from the Nimbus satellite, picked up at Ottawa and Frobisher Bay in Canada, are of much higher quality than those from the preceding U.S. meteorological satellite Tiros VIII.

The two Canadian stations were operated jointly by the Department of Transport Meteorological Branch and the National Research Council. NRC's Radio and Electrical Engineering Division developed equipment for use in reproducing picture transmissions from Tiros VIII, at which time only the Ottawa station was operated.

The equipment was designed specifically for high resolution photographic reproduction. It consisted of a simple yagi-type, azimuth-elevation mounted antenna, pointed by a novel antenna programmer, which is under patent investigation.

The video signals received were recorded on magnetic tape and the pictures were reproduced using a slow-scan TV screen and a Polaroid camera.

This kind of receiving equipment has roused a good deal of interest among other uses of the Automatic Picture Transmission System (APT) of the American meteorological satellites and other similar equipments are now under development.

Nimbus A, after a number of delays, was launched from the United States August 28/64. Excellent photographs were obtained by the Ottawa station. It was decided to go ahead with plans to establish

a second station at Frobisher Bay in order to study Arctic ice conditions on the spot. This station began receiving pictures only 5 days later during the arctic resupply operations.

Before Nimbus A ceased transmission September 21, the Frobisher station alone had made some 130 photographs worthy of study. These pictures ranged from Iceland to the MacKenzie River and from Devon Island to Cape Hatteras.

The Ottawa station received pictures of hurricanes Cleo, Dora, Ethel and Hilda over the Atlantic ocean and along the east coast. Many of the Ottawa pictures duplicated those made at Frobisher. Others were of more southern locations.

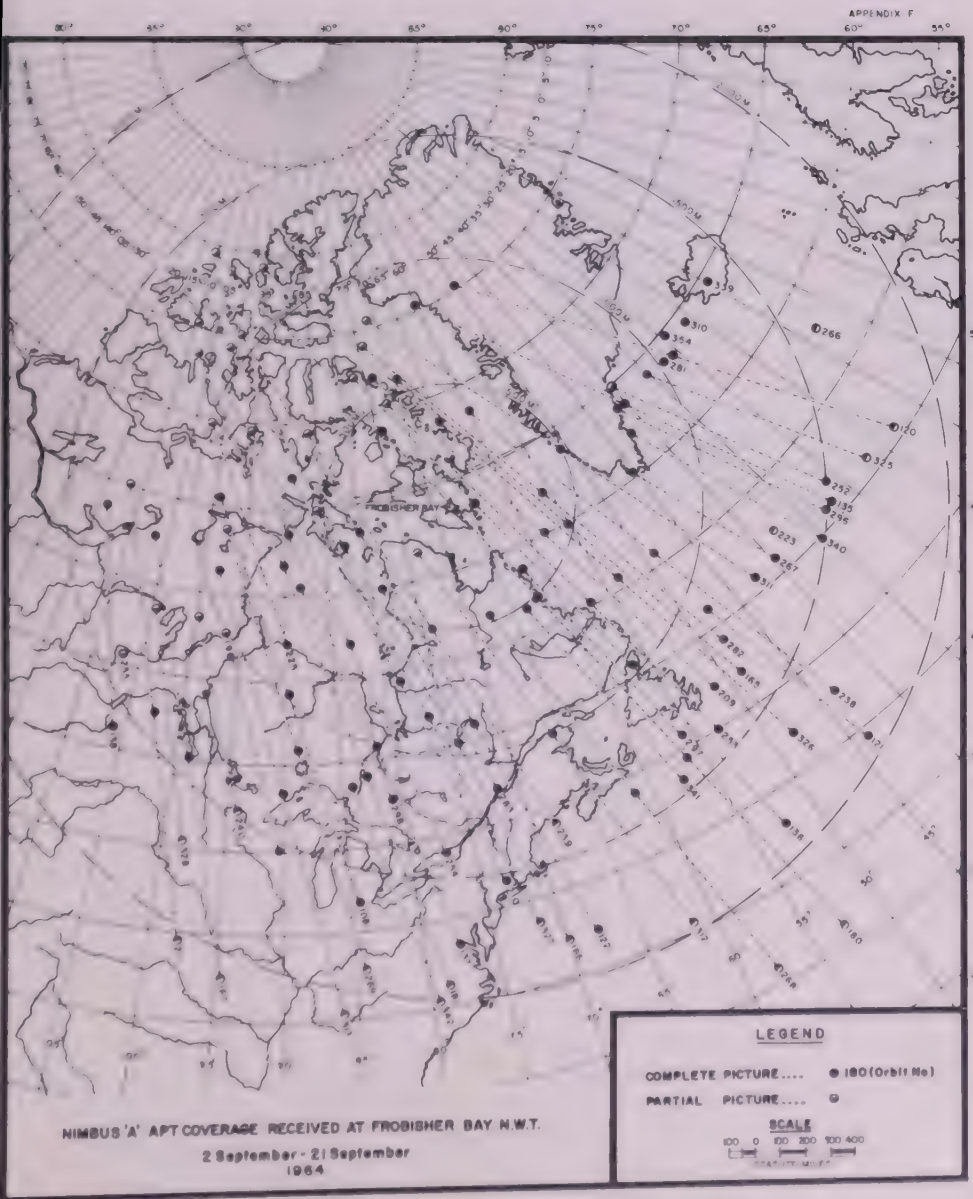
The resolution of ground details in the Nimbus A transmissions was about two to three miles, a considerable improvement over that of Tiros VIII transmissions.

The photographs show excellent meteorological details such as cloud formations, fronts, jet streams, intense lows, circulations and hurricanes, as well as ground pictures, ice and snow, and it is expected that similar pictures might be used in future for studying forest fires.

NRC is continuing to improve its ground station equipment, while the Department of Transport has announced that stations will be installed at Halifax and Toronto some time after mid-1965 for further evaluation and development of techniques for employment in the Meteorological branch.

Eskimos found Nimbus receiving equipment at Frobisher a fascinating diversion

Right: Nimbus APT coverage received at Frobisher Bay from 2 September – 21 September 1964. The black dots represent complete pictures received. The partial black dots are partial pictures received



NIMBUS 'A' APT COVERAGE RECEIVED AT FROBISHER BAY N.W.T.

2 September - 21 September
1964

International Recognition Given Scientist

Five honors have recently been given Dr. Gerhard Herzberg, director of the division of pure physics of the National Research Council. He has been awarded the Frederic Ives Medal (1964) by the Optical Society of America; appointed to the Pontifical Academy of Sciences of Vatican City; elected an honorary member of the Hungarian Academy of Sciences; elected second vice-president of the Royal Society of Canada; and has had the honorary doctor of science degree conferred on him by the University of British Columbia.

Dr. Herzberg is a leading authority on molecular spectroscopy. Apart from contributing to the knowledge of the structure of a number of well known stable molecules like hydrogen, oxygen, molecular nitrogen, carbon dioxide, acetylene and prussic acid, Dr. Herzberg and his group have in recent years particularly studied the spectra of so-called free radicals, like free methyl and free methylene and many others and from these spectra they have been able to determine the structures of these radicals.

As a result of one aspect of Dr. Herzberg's work, astronomers have been able to detect molecular hydrogen in planetary and stellar atmospheres.

nadian
cted President
International
ommittee

r. L. E. Howlett, director of the divi-on of applied physics of the National esearch Council, has been elected the eventh president of the International ommittee of Weights and Measures. his constitutes world recognition of Ca-adian research on the fundamental phy-cal standards of measurement.

The International Committee consists eighteen members, each elected for his ersonal scientific distinction. No more an one member may come from the me country.

The International Committee is the ecutive body of the International Bu-au of Weights and Measures. The Bu-au has headquarters and laboratories at vres, France, and operates under an ternational treaty signed in 1875, called e Convention du Mètre. Forty states e signatories to the Convention.

The International Bureau promotes re-arch for continuous improvement of e precision and accuracy of fundamen- standards for physical measurement – ch as length, mass, time, electricity, at, light, and ionizing radiations, and es to ensure world-wide uniformity in ch measurements. Industrial and scien-ic progress both depend on accurate easurement, and modern mass produc-n would be impossible without it.

The division of applied physics of the ational Research Council seriously en-ed the field of measurement research out fifteen years ago. Its contributions clude the following:

Research of the interferometric section helped prepare for the decision, made in 1960, to base the world's standard of length on a wavelength of light. Previously the standard had been the distance between two engraved lines on a platinum-iridium bar kept in a vault at Sèvres.

The interferometric section had the first comparator permitting length scales to be measured directly in terms of wavelengths of light.

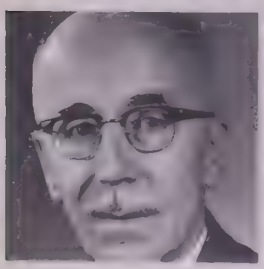
Work done in the heat and solid state physics section led to significant improvements of the International Temperature Scale.

The electricity section was one of the first groups in the world to operate a cesium "clock", which is paving the way for the second of time to be defined in terms of a vibration within an atom instead of the motion of the earth about the sun.

The radiation optics section is in the forefront of a re-examination of the adequacy of the present unit of brightness, called the "candela".

A recently created section of the International Bureau, to deal with ionizing radiations, called substantially on the knowledge and experience of NRC's group dealing with X-rays and nuclear radiations. This group is widely recognized for its work on measuring X-rays, neutrons, beta-rays, and the standardization of radioactive materials.

Dr. B. G. Ballard, president of the National Research Council, received a unique honor when he became the first Canadian to be made an honorary member of the Instrument Society of America.



Dr. Leo Marion, vice-president (scientific) of NRC was elected president of the Royal Society of Canada at its annual meeting.

J. E. Brown, chief librarian of NRC, was elected vice-president for North America for 1964-67 of the International Federation of Documentation (FID) in The Hague.

Dr. D. Makow, photogrammetric research section, division of applied physics, received the Heinrich Hertz Premium of the British Institution of Electronic and Radio Engineers for his "Stabilization of a Variable Quantity with Single Valued reference" in The Institution of Electronic and Radio Engineer Journal.

NRC Develops Tester for Emergency Doors

T. Luke, NRC's Fire Safety Officer, es out the new emergency exit door ter

Could an old lady open an emergency door if she had to? That, it appears, depends on the door. It has been found that the force required to swing open emergency doors in public buildings varies widely. Some swing easily. Some don't.

Possibly one reason why there is little uniformity is that there has never been a simple, easily managed and reliable way of measuring the force required to open a particular door.

Now, G. T. Luke, the National Research Council's Fire Safety Officer, and F. C. MacLean, formerly of the NRC National Aeronautical Establishment, have invented such a device. It is simple, easily portable and reliable.

It measures both the force required to push open the door and also the force needed to operate fastenings.

In use, pressure is increased on the door handle until either the panic latch breaks or operates, or the emergency door swings open. The force used is indicated by a pointer on a scale.

A patent has been applied for and efforts are being made to have the apparatus adopted in the National Building Code of Canada to enforce already existing requirements.

Super Fuels Possible for Rockets

A theory indicating that chemical rocket propellants can be turned into "super fuels" for space rockets has been described by Dr. H. J. Bernstein, of the NRC division of pure chemistry.

If it can be applied 100% effectively, a fuel such as hydrazine could be made about 50% more efficient with addition of only about 2% to its weight, said Dr. Bernstein.

The problem has been investigated only theoretically, but these fuels probably might be made. There would be difficulties in production for practical application and the efficiency obtained would depend on the degree of purity that could be obtained in practice.

Any fuel with a basic nitrogen atom or a basic oxygen atom (Lewis base) can be, in principle, stepped up in efficiency, he said.

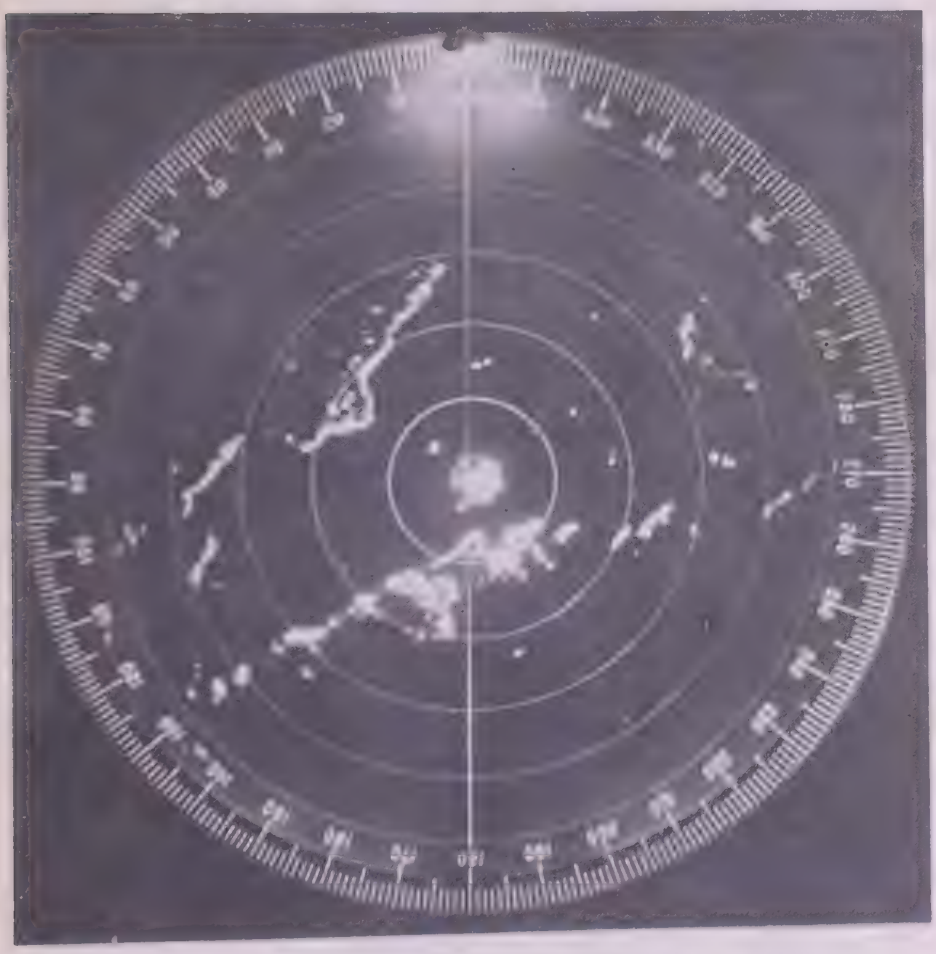
Injection of this 'souped up' fuel into conventional rocket propellants could increase the efficiency by 5% to 15%.

NRC RESEARCH NEWS

Vol. 16 — Issued by the Public Relations Office, National Research Council of Canada — No. 5

or: John R. Kohr — Assoc. Editor: Joan Powers

RADAR FOR SMALL VESSELS



Segment of film strip showing radar display of the approach to Kingston Harbour. Photo was taken during operational trials of NRC's transistorized marine radar.

-For story see following pages -

RADAR FOR SMALL VESSELS

A transistorized marine radar has been developed in the navigational aids section of NRC's Radio and Electrical Engineering Division. A prototype has already been delivered to a Canadian firm for commercial production. A second model underwent successful evaluation trials this summer aboard the M. V. "Radel II". Chief advantages of the new radar are: remarkably low cost, ease of installation, economy of operation, and a radical simplification of service problems.

Low Cost

It is expected that the new radar will be available for about half the price of any model now on the market: this means that, for the first time, purchase of radar equipment will come within easy reach of the fishing industry and of owners of small vessels plying inland and coastal waters.

Ease of Installation

In the crowded wheelhouse of a small vessel, where space is always at a premium, the most attractive feature of the new radar is that its main parts have been reduced to two light-weight "packages", the display chassis and the modular chassis. The display chassis containing the 10-inch cathode ray tube and its circuitry may be either table-mounted or bulkhead-mounted like a wall clock. The modular chassis may be conveniently located in an out-of-the-way spot as cabling from it to the display chassis can be extended to 20 feet without difficulty. The display package weighs only 31 pounds, the modular only 35, so that each can easily be handled by one person. (Design of the antenna, motor drive and radome for the production model has been left to the manufacturer.)

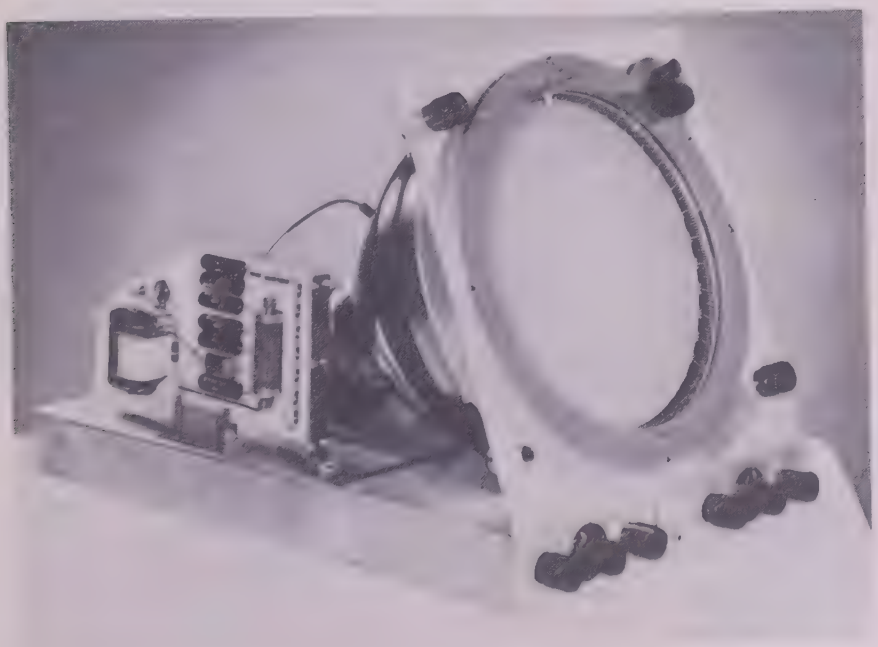
Economy of Operation

The entire system is so highly transistorized that it can be operated from a single 12-volt storage battery with a current drain of 7 amperes (excluding only the antenna motor).

Simplification of Service Problems

The display circuitry is confined to three plug-in boards, adaptable to printed circuit techniques, and built as complete sub-assemblies: this means that, if anything goes wrong, the faulty board need simply be replaced. Repairs can then be made as convenient.

New marine radar showing display chassis attached to modular chassis.



Display unit of new radar with chassis removed to show one of the plug-in boards.

ASSOCIATE COMMITTEE ON THE NATIONAL BUILDING CODE

The National Building Code of Canada, sponsored by the Associate Committee on the National Building Code and published by the National Research Council, is an advisory document written in the form of a building by-law for use throughout Canada. It is essentially a set of minimum regulations respecting the safety of buildings with reference to public health, fire protection and structural sufficiency.

Although it may seem strange to find an agency of the Federal government issuing a document which is essentially a local municipal ordinance, its purpose to promote public safety through its use as desirable building standards throughout Canada is gaining ever-wider acceptance. A recent survey shows that almost 55 percent of Canada's population live in areas where this model building by-law is now in use.

The Code was first printed in 1941; the second edition in 1953 and the third in 1960. Plans are already being made for the 1965 edition. Thereafter, new editions every five years may be expected. Although not a "best seller" by standards of fiction writers, almost 50,000 copies of the several editions, in English and French, have been distributed upon request to federal and provincial government offices, to municipal councils and building departments, to architects, engineers, universities, and others. Six of Canada's ten provinces now make direct mention of the Code in twelve separate provincial statutes. It is also the standard reference for building design and safety in departments of the Federal Government.

A major step in the development of uniformity of Canadian building regulations was achieved with the 1960 Code which contains a special supplement dealing with housing requirements. Those Housing Standards have been adopted by Central Mortgage and Housing Corporation as their minimum standards for house building, under the terms of the National Housing Act. This means that there is now one set of standards for housing in Canada, thus eliminating the long-standing problem where a local building by-law and the C.H.M.C. housing requirements differed.

ASSOCIATE COMMITTEE ON THE NATIONAL BUILDING CODE

(Concluded)

The Associate Committee enjoys a close tie with the Division of Building Research which continues to provide its Secretariat and to supply valuable information arising from research studies on building matters for the advancement of the Code. These studies include such matters as snow loads on roofs, nailing requirements for wood roof trusses, the use of wood-fibre ducts for hot air heating in basementless houses, roof truss designs, and fire resistance of typical wall structures. The results of such studies provide the Associate Committee with the information required to make the Code a living and up-to-date document and one of the best building codes in the world.

- J.M. Robertson -

NEW LOOK AT "LIGHT AND LIFE"

The Canadian Photobiology Group - l'Association Canadienne de Photobiologie - was formed during the first Canadian conference on photobiology held at Carleton University, Ottawa, Sept. 9-10, 1963. The aims of the Group are to promote photobiological research in Canada, arrange future meetings and establish liaison with other national and international photobiological organizations. Members of the executive include: Prof. G. Krotkov, Dept. of Biology, Queen's University, Kingston, Ont. (Chairman), and Dr. Paul-E. Vézina, Laboratoires des recherches forestières, Ministère des Forêts du Canada, Sillery, Que. (Secretary-Treasurer).

The two-day conference, sponsored by the Royal Society of Canada and the National Research Council, was organized by an Interim Committee under the chairmanship of Dr. PAUL R. GORHAM, head, plant physiology section, NRC's Division of Applied Biology. Some 60 to 80 scientists and students attended.

NEW LOOK AT "LIGHT AND LIFE"

(Continued)

What is Photobiology?

Photobiology is not so much a new science as an old science that is attracting increased attention. Topics in photobiology which have been studied for a long time are photosynthesis, vision and sunburn.

The newer topics include such things as photoperiodism in plants and animals (sex cycles), photomorphogenesis (shape changes caused by light) - in plants, photoreception in animals (other than vision), bioluminescence in plants and animals (luminescent bacteria, fireflies), phototaxis (movement towards or away from light).

The search for trace pigments that absorb light, participate in some photochemical reaction (s), and trigger biological responses (the latter often expressed at a much later date) is being intensified as the result of new insights, methods, instruments, and training.

Dr. D. J. C. Friend, plant physiologist at the Plant Research Institute, Dept. of Agriculture, Ottawa, has prepared the following non-technical outline of four important areas in photobiology.

Role of Pigments

When light falls on an object, one of two things happens: it is either reflected or absorbed. To have any effect on a living system absorption of light must take place; the substance doing the absorbing is often a brightly colored pigment such as the green chlorophyll in the leaves of plants or the visual purple in the retina of animal eyes.

One of the ways to identify the particular pigment responsible for light-stimulated reactions is to irradiate a plant or animal with light of different colors. In this way it has been found that red and dark-red light can have very profound effects on many aspects of plant growth. The pigment responsible has now actually been isolated by workers in the United States and given the name of "phytochrome". This pigment has some remarkable properties: when illuminated with red light it changes to an activated form that triggers various responses; for instance, seed germination, flower formation, reddening of stems, stunting of stems, unbending of seedlings. Other

activities of phytochrome include the reddening of apples and tomatoes. The active form of phytochrome is changed back to the inactive form by dark-red light, so that the relative amounts of red and dark-red light present will determine the triggering ability of the pigment. In addition to phytochrome there is increasing evidence that another pigment exists that is activated most by dark-red light and can promote flowering in wheat and barley.

Photosynthesis

The most important action of light on living organisms is photosythesis, the building up of sugars from the carbon-dioxide of the air in the green leaves of plants. Without photosynthesis there would be no green plants, no food for animals, no coal or oil -- in fact, no life as we know it! The energy that is used to make the sugars comes from the light absorbed by the green pigment chlorophyll. It now appears that the color of light can determine the uptake of oxygen. Field measurements of both the quantity and quality of light help us to understand the way in which light is trapped by different crops, perhaps eventually leading to further improvements in yield through better utilization of sunlight. New instruments have been constructed for measuring the quantity of light falling on a crop and for measuring the energy in different regions of the spectrum. Some of these instruments are portable for use within the crop itself; one of these instruments is even able to "put out a feeler" which measures the light while moving along between the leaves of a crop. The forests forming such a dense cover over much of our land are one of the most efficient "crops" for using the light energy from the sun; methods have been worked out for measuring the light energy that filters through the forest canopy and is therefore available for plants underneath.

Sensitivity of Animals to Light

Human beings and animals are sensitive to light in a surprising number of ways; for instance, the effect of light on pigments in our skin must be evident to anyone who has ever been sunburned! When we "see" light or color, we are actually responding to nerve impulses triggered by the absorption of light in the pigment of the eye. The pigment that absorbs light is situated in special cells of the retina called rods and cones; the rods are more sensitive to low light intensity than are the cones.

NEW LOOK AT "LIGHT AND LIFE"

(Concluded)

Many animals, such as rats and mice, are active at night, quiet by day. It has recently been found that the Arctic lemming remains far more active in light than the deer mouse; a correlation has been found between this difference in activity and retina composition; the retina of the deer mouse is composed mainly of rods, while there is strong evidence that the retina of the lemming contains only cones.

The attraction that light has for insects is well known, but the reason for it is not yet completely clear. Sometimes it seems to be advantageous for insects to avoid light; for instance, the maggot of the common housefly moves away from light shining in a certain direction, although it can't "see" the light because it has no eyes.

"Biological Clocks"

In the aphids (greenfly) it is the length of the daily period of illumination that determines whether the female gives birth to living young or lays eggs. In the short days of fall, eggs are laid, but lengthening the days by means of artificial light causes the birth of living young, as occurs under the long daylengths of mid-summer under natural conditions. This control of the reproductive cycle in both animals and plants by daylength is called photoperiodism, and is the cause of such seasonal events as the flowering of chrysanthemums in the short daylengths of mid-summer. The phytochrome pigment in plants may act as a sort of "biological clock" against which the natural environment can be compared. In this way daily rhythms in leaf movements and seed germination may carry on even in continuous darkness or continuous light. In other cases the "biological clock" may be controlled by outside influence, some as subtle as daily changes in the earth's magnetic field. Scientists are still arguing about whether the timing control is within the animal or plant itself, or whether the clock is maintained by environmental influences. There is even some evidence that invisible rays given out during periods of sun-spot activity may influence seed germination.

NATIONAL SERVICES OF THE NRC LIBRARY

In the world of libraries, the Library of the National Research Council holds an unusual and perhaps unique place, for it performs two closely related, though oft-times conflicting and incompatible roles.

Its original and obvious role is that of a library providing scientists and engineers at the National Research Council with the publications and information required in their research activities. Its second, and more recent role, is that of a National Science Library, actively serving the entire Canadian scientific community.

The NRC Library, begun some 40 years ago, has grown from an initial collection of 1000 volumes to its present half-a-million holdings. Its national services - inevitably an expansion of those services provided to the Council's own scientific staff - extend to provincial research councils, government departments, industry, and the universities throughout the country.

By the very nature of science publishing, the major portion of a national science library's collection consists of files of scientific and technical journals, technical reports, and other documents. To exploit fully these resources - which continue to grow at an average rate of 500 items per day! - Canadian scientists must be continually aware of the extent of this collection.

To accomplish this, the Library issues annually, a complete record of its serial holdings. Thus, Serial Publications in the Library, 1963 has been distributed to all Canadian university libraries, thereby placing at the service of professors, researchers, and students alike, reports and publications which would not otherwise be available to them. Libraries of provincial research councils and government libraries have also received the current issue, which may be purchased by other interested organizations.

The "big brother" to the Library's list of serials is its Union List of Scientific Serials in Canadian Libraries, containing over 21, 000 entries representing holdings, in the general field of science, technology, and related subjects, of over 150 cooperating libraries. With the aid of this volume any researcher is able to locate at a glance any technical or scientific periodical available in any of the contributing libraries throughout Canada.

Copies of the original 1957 volume and the 1960 supplement may be ordered directly from the Library, National Research Council, Ottawa.

The Library also publishes twice each month Recent Additions to the Library which lists by broad subjects its latest major additions, and is distributed free of charge to Canadian libraries and other interested organizations. If any of these items are not available through local public or university libraries, they may be obtained by placing a request directly with the NRC Library.

Basically, any item held by the Library is available to any one any where in Canada through inter-library loan. However, potential borrowers may determine whether a publication is available locally, by contacting their local public or university library, or by consulting the basic and supplementary Union List of Scientific Serials in Canadian Libraries. Any item which cannot be lent is usually available through a rapid and inexpensive photocopying service. In the case of Canadian libraries, when a request for a loan cannot be met, the required pages are copied and forwarded without charge.

A science library is a dynamic organization which cannot operate solely as a repository for the world's output of scientific and technical literature. It must develop and provide staff and techniques which will permit the expeditious retrieval of any publication or information held by it or any other library in the world. Accordingly, NRC's National Science Library operates a Science Information Service staffed by people trained in the sciences and librarianship. The services of this unit are available without charge, and consist of the following activities:

(i) Compilation of bibliographies;
(ii) Literature searches;
(iii) Identifying and locating obscure publications and references;
(iv) Answering requests for scientific and technical information.

In carrying out these services, the NRC Library seeks to supplement rather than replace existing library services. It assumes that enquirers requesting literature searches or bibliographies have made a preliminary search in those science collections which are available locally.

In addition to the foregoing services, the Library operates a Translations Section to prepare translations requested by NRC scientists. All papers translated are published in the Council's Technical Translations series and are made available, either free of charge or for a nominal sum, to the scientific community at large. All translations published to date are cited in the List of Technical Translations, which together with periodic supplements, is available upon request.

Of greater interest to Canadian researchers and librarians is the Index of Scientific Translations maintained at the NRC Library. This Index, which now contains well over 90,000 cards, lists by author, English or French translations of scientific and technical papers published in all parts of the world. These translations are reported to the Library by such organizations as the U.S. Office of Technical Services, ASLIB, EURATOM, and the newly formed European Translations Centre.

Canadian scientists and librarians are urged to check this Index in person, or by mail or telephone, when they are seeking a translation of a foreign language paper, or are planning to prepare a translation. If the translation is recorded, information can always be provided as to its availability and, in many cases, a copy can be supplied from the Library's extensive file of translations.

These services provided by NRC's National Science Library, together with the specialized knowledge and practical experience of the Council's scientific and technical staff - often invaluable in answering enquiries - combine to keep scientific information readily accessible to Canadian researchers.

* * * *

INDUSTRIAL RESEARCH AND DEVELOPMENT EXPENDITURES IN CANADA 1961 - Published by the Dominion Bureau of Statistics, November, 1963, Catalogue No. 13-520. Price 50 cents.

This publication is the fourth biennial survey conducted by the Dominion Bureau of Statistics in cooperation with the National Research Council. It presents an estimate of the magnitude and direction of the research and development program undertaken by Canadian industry in 1961, and provides an indication of the relative size of the 1962 expenditures.

HONOURS AND DISTINCTIONS

DR. LÉO MARION, Vice-President (Scientific) of NRC, has been awarded the PRIX JECKER, by the Academy of Sciences of Paris, for his work on the structure of alkaloids.

Founded in 1851, the Academy's most important chemistry prize is awarded to the author of the most useful work on organic chemistry, or to the chemist whose collective works have contributed most to the progress of organic chemistry.

Dr. Marion becomes the first Canadian to receive this coveted Prize, which was awarded to Louis Pasteur over a century ago.

DR. R. N. JONES, head, organic spectrochemistry section, NRC's Division of Pure Chemistry, has been awarded the first Honorary Membership of the Canadian Association for Applied Spectroscopy.

The award recognizes Dr. Jones' scientific work - which includes cancer research with the Sloan-Kettering Institute in New York - as well as his efforts towards international coordination in his field.

BOOK NOTES

COLOR IN BUSINESS, SCIENCE, AND INDUSTRY, second edition by Deane B. Judd, colorimetry and photometry section, U.S. National Bureau of Standards, and GUENTHER WYSZECKI, head, radiation optics section, Division of Applied Physics, National Research Council of Canada. Published by John Wiley and Sons, New York - London, 1963: 500 pages.

Incorporating the important practical and theoretical advances that have occurred in colorimetry in recent years, the book treats both the basic concepts of human color vision and the practical problems of color measurement, specification and control. Today's tools and techniques that are basic to color control in business and industry are described and their limitations are carefully considered. The style of the book is surprisingly crisp and exciting. Moreover, the text is supplemented by numerous illustrations, many of them new (and quite a few of them from sketches by Dr. Wyszecki himself). The subjects treated have been selected not only to satisfy the immediate requirements of the color technologist but also to aid the research worker in improving existing methods of color measurement.

NRC RESEARCH NEWS

NOVEMBER - DECEMBER, 1965

Vol. 18, No. 5, November-December, 1965. Published by the Public Relations Office, National Research Council, Ottawa. *Material may be reproduced with or without credit to NRC Research News unless a copyright is specifically indicated.*

Fetal Electrocardiograph	3
Lobster Splitting Machine	4
Drop of Boiling Water	5
Separation Process	6
Aid for Spine Surgery	8
Operations Research	10
Guildline Instruments Limited	11
New NRC Radiation Laboratory	12
Microwave Drying Machine	13
NRC Role in Alouette II	14
Probe Microphone	16

Cover: New aerial view of the Montreal Road Laboratories of the National Research Council in Ottawa. Photo by John de Blois, NRC.

Photo Credits: Radiation Building, Lobster Machine by Department of Public Works; Thermometer Bridge by Guildline Instruments Ltd., Alouette II launch by USAF; others by NRC.

Fetal Electrocardiograph

Dr. Schuler (left) explains the operation of his new preamplifier to Medical Post reporter Dick Cassells.

A team of doctors from the National Research Council and the Ottawa Civic Hospital has developed a simple low-cost preamplifier to help obstetricians to keep a closer watch on the development and condition of unborn children.

Its inventor hopes the machine will become as popular among physicians treating expectant mothers, as the stethescope which has been used since the dawn of modern medical science as an aid in the diagnosis and treatment of patients.

Used in conjunction with any standard electrocardiograph, the machine enables physicians to record the faint heartbeats of an unborn child. The faint fetal heartbeats cannot be recorded by a standard electrocardiograph as they are masked by the mother's heartbeat, her muscular electrical activity or by external electrical interference.

Last year, the Instrument Section of NRC's Radio and Electrical Engineering Division developed a special electrocardiograph for recording the heartbeats of unborn children. However, this machine is expensive, costing in the neighbourhood of $2,000.

In an effort to encourage wider use of fetal electrocardiography, Dr. Graham Schuler of the Instrument Section has developed a simple preamplifier to pick up fetal heartbeats and feed them into a standard electrocardiograph. This machine produces a graph which distinguishes the fetal heartbeat from that of the mother.

Dr. Schuler said it is not claimed that this device has any virtue other than its simplicity of operation and very low cost which will make the benefits of fetal electrocardiography more widely available.

The preamplifier, which is about the size of a donut, can be manufactured and sold for about $60 to $100. It was displayed for the first time by Canadian Patents and Development Limited, a subsidiary of NRC, at the Canadian Electronics Conference in Toronto Monday, October 4.

The new machine will be useful in determining whether an unborn child is alive or dead. It will help doctors to determine how a baby is getting along and whether it is in trouble due to labor, knotting or occlusion of the umbilical cord or because the mother is hemorrhaging. In addition, the machine will be useful in indicating the position in which a baby is lying in the uterus, monitoring the baby's heartbeat during labor, determining the best time for performing a Caesarean section or inducing labor in incompatibility conditions and in testing an unborn baby's heart condition by temporarily lowering the mother's supply of oxygen.

Dr. Schuler said the preamplifier requires the use of three electrodes which are placed on the mother's abdomen. The fetal heartbeats then are amplified selectively to help the doctor determine their characteristics.

In the first 10 tests by inexperienced operators at the Ottawa Civic Hospital, fetal heart rates were recorded and determined in each case. These tests were conducted under the direction of Dr. J. C. Whyte and Dr. Irving Glass of the Ottawa Civic Hospital.

"The low cost, small size, operational simplicity and routine usefulness of this preamplifier is intended to parallel the features of the common stethescope," Dr. Schuler said. "Furthermore, though both are not instruments of ultimate sensitivity and versatility, both are graced with the ability to provide generally useful and occasionally an invaluable piece of information."

Lobster Splitting Machine

Mr. Featonby demonstrating the operation of his machine.

Mechanization has broken the back of another ancient method of food processing.

A National Research Council design engineer has developed a unique splitting machine for use in lobster canneries. It promises to end the time-consuming task of splitting lobster shells by hand to remove the meat for canning.

The machine, developed by Joseph Featonby of the central design office of NRC's Division of Mechanical Engineering, also is expected to increase the efficiency of lobster canning operations and help reduce canning costs.

NRC developed the machine at the request of the government of Prince Edward Island. The request was made by the province's Department of Fisheries in an effort to assist the canning sector of the lobster fishing industry.

Mr. Featonby said the machine will be sent to the Prince Edward Island Fisheries Department in a few weeks for endurance tests in a cannery. The main objective of the tests will be to determine the life of two circular cutters which are used to split lobster shells into halves.

Removal of lobster meat from the shell now is done in canning factories by operators using a large knife or cleaver to break the shells. Besides being a slow process, operators find it difficult to keep intact the choice meat in the lobster claw.

In Mr. Featonby's machine the cooked lobster is fed into a chute head first and is carried through the chute by a pulley arrangement. The lobster is centralized in the chute with a concave guide.

As the lobster moves down the chute, it is carried through two powerdriven circular cutters. One cutter is on the bottom of the chute and the other on a pivoted arm which is held firmly against the lobster's back by a spring arrangement.

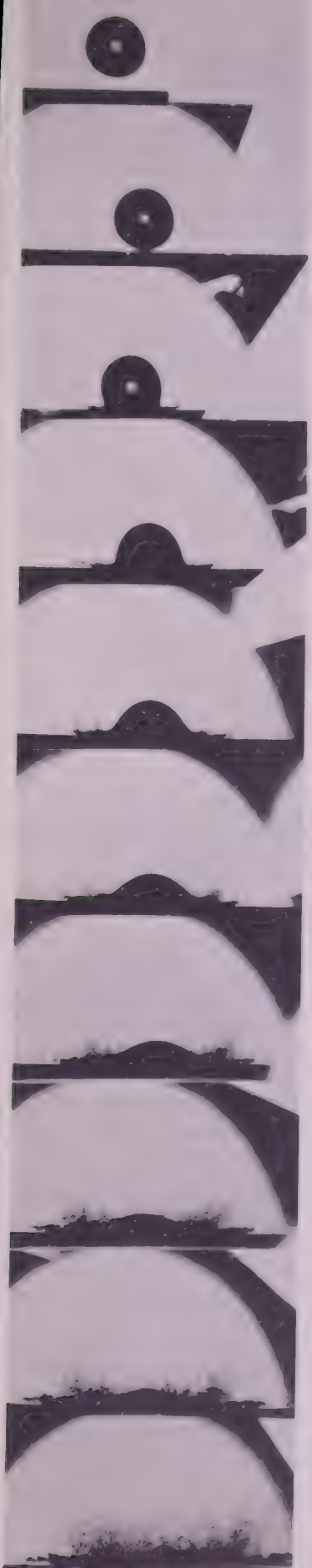
The operator manipulates the concave guide and the cutter on the pivoted arm to compensate for varying differences in the size of lobsters. The same procedure is followed in the splitting of the claws into halves.

Mr. Featonby said one machine can process from 300 to 400 lobsters an hour, depending on the skill of the operator. This is greatly in excess of what can be done by hand.

The cost of the machine will not likely exceed $250.

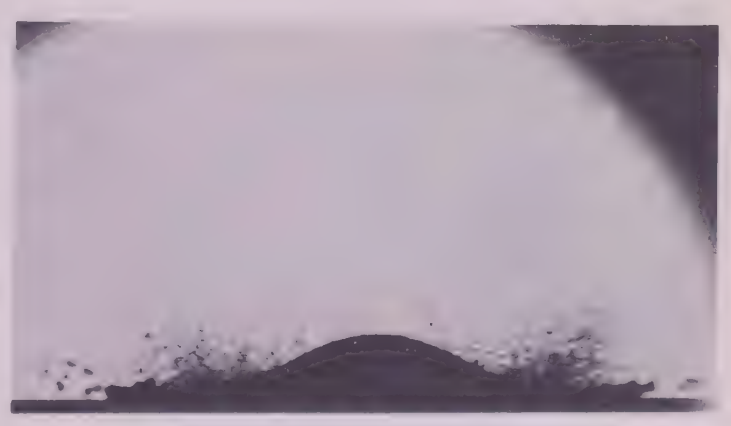
"The machine may also find a market in large hotels and restaurants which serve lobster in big quantities," Mr. Featonby said.

"The gourmet probably will object to being served split lobster on the grounds that part of the fun of eating lobster is digging the meat out of the shell. However, most people will likely welcome the change of being able to eat lobster without engaging in a wrestling match."



Water Drop Boiling on a Hot Silver Surface

The 10 consecutive photographs (left) show a drop of water falling on a hot surface with a temperature of 914 degrees F. The photographs were taken with a special camera at 5,000 frames a second. The lapse of time between the first and 10th photographs is one 500ths of a second. The photographs were taken during experiments on the cooling of hot surfaces by water drops conducted by Dr. Peter Savic of the Gas Dynamics Section of NRC's Division of Mechanical Engineering.



Detail of Boiling Drop

Dr. Sourirajan examines membrane used in his separation process.

New Separation Process at NRC

Chemical engineers at the National Research Council are developing a process which, in principle, can be used to separate any substance in liquid or gaseous solution.

Dr. Srinivasa Sourirajan of the chemical engineering section of NRC's Division of Applied Chemistry says this separation technique may bring major benefits to the entire chemical process industry.

Dr. Sourirajan first started work on the process at the University of California in 1956. He has continued to extend the scope of the process since joining NRC in 1961.

The technique was developed originally to remove salt from sea water. And it now is emerging as potentially the most versatile of all water desalination processes.

Dr. Sourirajan's Reverse-Osmosis membrane separation process involves the use of a porous cellulose acetate membrane which has a preferential attraction for fresh water and a similar repulsion for the salt in the solution. Fresh water forms a thin coating on the surface of the membrane and is forced through the membrane by pressure.

In his initial experiments at the University of California, Dr. Sourirajan obtained only a few drops of water a day from a square foot of membrane.

Dr. Sourirajan was joined in the research project by Dr. Sidney Loeb in 1958, and by 1960, they had developed the process to the point where it was capable of desalting seawater at a rate of five to ten gallons a day per square foot of membrane at a pressure of 1,500 pounds per square inch. After joining NRC, Dr. Sourirajan made further improvements to the technique and increased the potable water yield from 20 to 35 gallons daily. A similar advance also has been achieved in the United States.

He has extended the scope of the process and now is developing it as a general technique for the possible separation of almost any substance in liquid or gaseous solution. This approach offers wide applications, including water pollution control, water renovation, waste-reclamation

and petroleum fractionation.

"Experiments to date demonstrate that the Reverse-Osmosis membrane separation process is capable of tremendous versatility in chemical process engineering," Dr. Sourirajan says.

"The process, in principle, is applicable for the separation, concentration or fractionation of any substance, organic or inorganic, in aqueous or non-aqueous solution, in the liquid or gaseous phase."

Once the technology is foolproof, the technique could be used to:

1. Separate pollutants from wastes pumped into rivers and lakes.
2. Reclaim polluted water in areas where the fresh water supply is limited — such as the Arctic in winter and in spaceships.
3. Concentrate maple sugar from the sap of maple trees by removing the water without using heat.
4. Separate gasoline, kerosine and other products from petroleum, also without heat.

In Dr. Sourirajan's separation process, fresh water is forced through minute holes in the membrane which are probably about a few hundred millionths of a centimetre in diameter. These holes, however, account for only a very small fraction of the membrane's surface, and hence the technology of porous membranes still has wide scope for improvement.

Dr. Sourirajan and his colleagues now are attempting to increase the number of holes in the membrane without increasing their size. This would increase considerably the amount of fresh water being forced through the membrane.

"The design of the membrane is the key to this process," Dr. Sourirajan says. "The one which has now been developed can separate many kinds of substances dissolved in water. Other membrane designs will have to be developed for other separation jobs."

Dr. Sourirajan says application of the process as a general separation process has great significance. This aspect of the development, he says, is just beginning to be recognized by industry in general.

Technical officer A. G. Baxter operating the laboratory equipment used in the process

Pre-Operative Spinal Curvature

A mechanical aid for orthopaedic surgeons treating patients for scoliosis (curvature of the spine) has been developed by a National Research Council engineer.

One treatment for correcting this condition involves surgery during which a system of metal rods, implanted in the body, is used to straighten the spinal column.

Hooks on the rods are attached to a number of vertebrae. Forces are then applied using a special instrument called a spreader. The forces created by this procedure straighten the curved section of spine. The rod and hook assemblies remain permanently implanted in the body.

The safe force which may be applied with the spreader is limited not so much by the strength of the rods as by the strength of the vertebral bone.

The amount of force that various parts of the vertebra can withstand ranges from 20 to 300 pounds. However, in using the original spreader surgeons had

Aid for

Spreader with

no indication of the force they were developing.

In July, 1964, the Orthopaedic Division of the Department of Surgery, Ottawa Civic Hospital with the University of Ottawa asked NRC's Mechanical Engineering Division if a means could be devised for measuring the forces being developed by the spreader.

The job was given to S. H. G. Connock, head of the Division's instrument laboratory. In association with N. L. Geick, a laboratory associate, Mr. Connock successfully modified the standard spreader so that the force developed with the tool is indicated by a pointer-scale arrangement.

"Surgeons now know the exact pressure they are applying," Mr. Connock said. "The modification greatly reduces the risk of bone fracture due to excessive pressure, yet enables the surgeon to apply the maximum safe force having regard to the strength of the particular vertebrae locations so that the greatest corrective action can be achieved."

Post-Operative Appearance

Surgery

arrangement.

Operations Research

The effectiveness of operations research can be nullified if the executives of a company or other organization using the research are not sufficiently receptive, Dr. John Abrams, of Toronto, told a recent international meeting of the Institute of Management Sciences in Vienna. His trip was sponsored by the National Research Council.

Organizations have actually lost money by installing expensive operations research systems, including computers, not because of failure in the systems but because the executives who had to handle the results were not oriented toward doing so, he said.

Dr. Abrams is a former president of the Canadian Operational Research Society, associate professor of Industrial Engineering and director of the diploma course in Operations Research at the University of Toronto. He is also visiting professor of Commerce at Queens University, Kingston.

A substantial change is taking place in industry toward the use of more academically qualified men, he said. Canada is somewhat slower than Britain and the United States in introducing operations research, the purpose of which is to provide the decision makers with technical data on which to base their judgments.

Thus, operations research could assist a company in best employing data bearing on planning, inventory control, production control, investment selection and distribution.

"This field of operations research has grown so rapidly that today there is scarcely a major company in the United States without trained people in the field. There are more than 8,000 members of operations research societies in the U.S.

"In Britain between 200 and 300 people enter the field every year," he said.

"So far, in Canada, we have been much slower. We graduate — and I'm guessing — about 35-40 reasonably qualified people a year, with only two-thirds of them directly prepared for the field."

Because technical information produced by operations research people depends for its usefulness on an informed and enlightened management, industry is finding it increasingly necessary to raise management standards, he said.

"Twenty years ago, management frequently operated on experience alone. Today, you find management positions occupied to a much greater extent by people with experience plus a degree in mathematics, statistics or engineering."

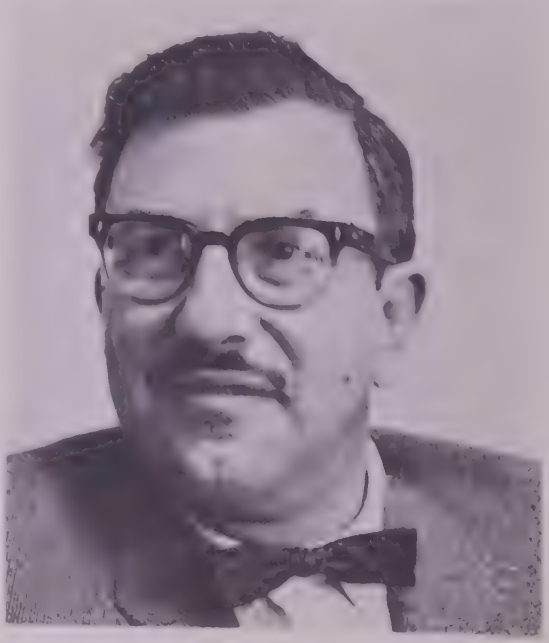
In Canada, it is not possible to find the number of academically trained men that industry is seeking, he said. An alternative would be to send experienced executives back to college for special courses. These courses should not necessarily be limited to the specialty in which the executive functions but could include the humanities to broaden the background and receptivity of the executive.

"We believe that in Canada the role of the university is to ensure that there is a nucleus of people who are keeping up with the theoretical advances and with industrial progress," he said.

This need is not always recognized by the organization in which these executives function, he said.

"Even an engineer, trained only a few years ago, needs to return for refresher courses. He won't have studied things like statistics and probability, which he will need as an executive."

Dr. John Abrams



Guildline Instruments Ltd.

Four British-born engineers, aided in large measure by the National Research Council, have proved it's possible to build a Canadian company producing highly specialized instruments.

Guideline Instruments of Smiths Falls, Ontario, has done so by manufacturing a series of quality electrical measuring instruments and concentrating on export markets for most of its sales.

This policy has been so successful that 80 per cent of Guidline's growing sales are in the United States and the company now is looking for markets abroad.

Many of the instruments being produced by Guildline were developed as research tools by the Division of Applied Physics of the National Research Council. They were adapted by the company for commercial use.

John Sutcliffe, Guildline's general manager, says it is in some measure due to the originality of NRC design that the company has been able to develop an export business that exceeds its domestic volume by several times.

Mr. Sutcliffe arrived in Canada in 1951 with engineers George E. Garforth, Donald V. Buxley and Frank E. Halliday, to set up a Canadian branch of the British firm of H. Tinsley & Company, veteran manufacturer of electrical standards and measuring instruments.

The Canadian branch was established at St. Jerome, Quebec, and operated in that city until 1957 when Tinsley decided to sell its Canadian assets. The four engineers bought the firm from their employers, named it Guildline Instruments and moved its location to Smiths Falls to be near NRC.

Mr. Sutcliffe says that since 1957 the company has concentrated on the development of quality laboratory instrumentation with particular emphasis on voltage calibration equipment based on the standard cadmium cell.

There is a comparatively small Canadian market for the instruments manufactured by Guildline. However, the company has found a lucrative market in the United States for high quality test instruments and now is seeking additional markets in Europe, Australia and South Africa.

When the company opened its Smiths Falls plant in 1957, it had six employees. Today Guildline has 70 employees working in a 12,000 square foot plant that is twice the size of the original opened in 1957. These workers have seen Guildline sales rise eight-fold in eight years.

Some of the NRC designed instruments being produced by Guildline introduce a completely new approach to a measuring problem. In this category the company now is producing and exporting an instrument for measurement of resistance to a precision of one part per million, and a bridge for temperature measurement to a thousandth of a Centigrade degree.

In all cases where an NRC invention has been taken up by Guildline for commercial development and sale, the company has been licenced to manufacture on a royalty basis by Canadian Patents and Development Limited, a subsidiary of NRC.

Mr. Sutcliffe says that in some cases it has been necessary at several stages of commercial development for the company to call on the services of the NRC inventor for advice or information.

"On such occasions without exception, advice and assistance has been readily forthcoming," Mr. Sutcliffe says. "This kind of assistance from a laboratory of the calibre of NRC would normally be financially inaccessible to a small manufacturer."

Technician operating direct reading thermometer bridge.

New NRC Radiation Laboratory

A new laboratory complex for the precise measurement of ionizing radiations of high energies and intensities will be built at the National Research Council's Montreal Road Laboratories in Ottawa.

The laboratory will provide facilities for the establishment of standardization procedures for the measurement of electrons, X-rays and neutrons of higher energies and intensities than can presently be measured at NRC. These measurements and standards will ensure the safer use of higher energy ionizing radiations by hospitals, research institutions and industry.

Until recently, existing facilities of the X-Rays and Nuclear Radiations Section of NRC's Division of Applied Physics have been adequate to meet all Canadian requirements in the fields of X-ray, radionuclide and neutron standardization and at the same time establish an enviable international reputation.

New facilities are required because Canadian hospitals, research institutions and industry now are using substantially higher energy radiations than those that can be produced with existing NRC equipment.

NRC cannot now provide the measurements and standards required in the higher energy regions for scientific investigation, public health and protection. The acquisition of the new equipment will remedy this situation.

The equipment for the laboratory will include a 35,000,000 electron-volt linear electron accelerator for standardization and research in the measurement of high voltage X-rays and electrons and a 4,000,000 electron-volt positive ion accelerator for neutron standardization and measurement and for the study of neutron reactions.

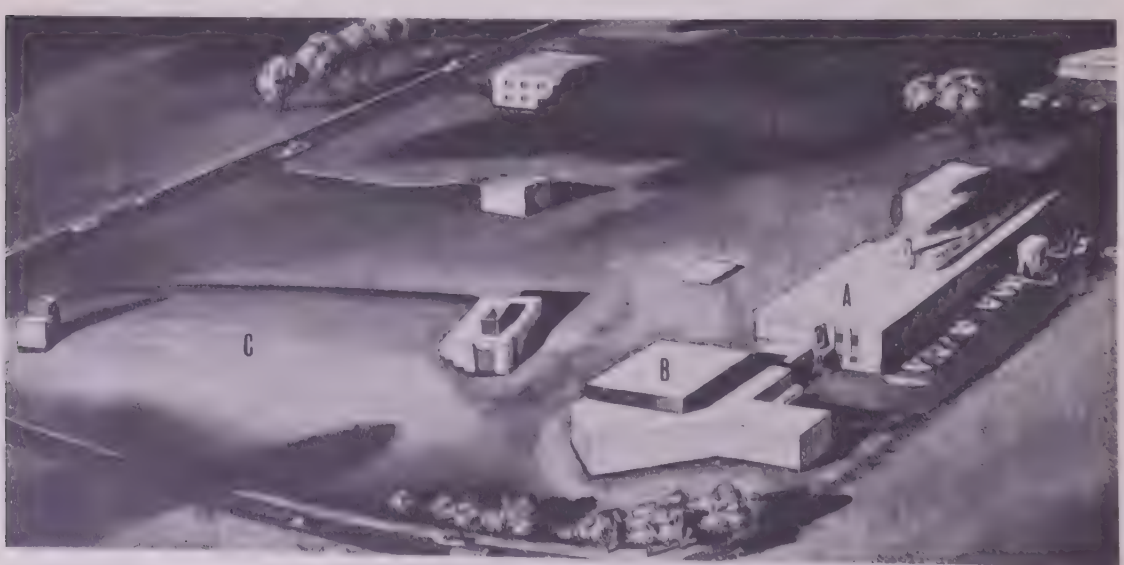
The complex involves the construction of an addition to the section's existing building and two adjacent laboratories to house the accelerators. The new equipment is expected to be in operation sometime in 1967.

The laboratory for the positive ion accelerator will be located adjacent to the addition to the present building.

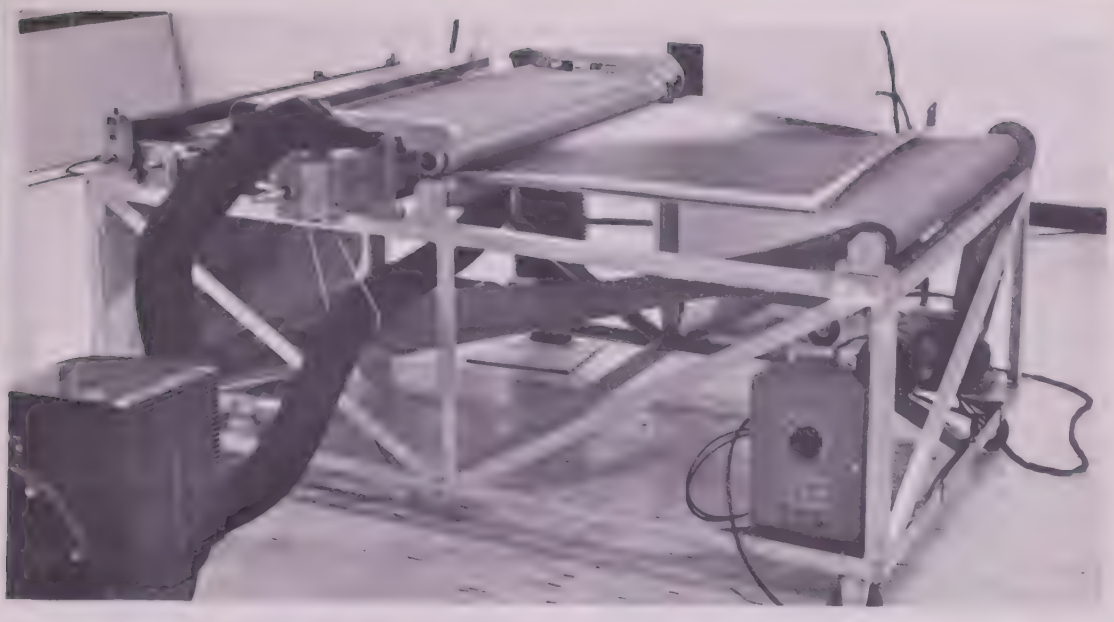
The accelerator will be located at one end of the laboratory. Electron beams from the accelerator will be directed by a switching magnet in seven directions into a large experimental area. The section where the accelerator will be located will be shielded to contain radiation.

The laboratory for the linear accelerator will be located 100 feet away from the addition and the two structures will be connected by a tunnel.

This laboratory will have a concrete ceiling four feet thick and will be covered with 10 feet of sand for radiation protection. As a further precaution, the laboratory will be air-conditioned with a system that replaces the air in experimental areas continuously.



A. Addition to present building. B. Positive ion laboratory. C. Linear accelerator.



Microwave Dryer Developed by NRC.

The National Research Council has developed a microwave machine for the rapid drying of large black and white photographic prints. It reduces the time required to dry a 40-inch-square print to some five minutes from 12 hours or more.

The idea of using microwaves to dry photographic prints was proposed by Ted Greenway, general manager of the Canadian Government Photo Laboratory, National Film Board.

Last January, Mr. Greenway put his proposal before the antenna engineering section of NRC's Radio and Electrical Engineering Division, which has extensive microwave facilities.

The section liked the idea and decided to build a prototype dryer six feet wide and 10 feet long.

Wet photographic prints are placed on a fibre-glass mesh conveyor belt and drawn through a roller to remove excess water. They then go through a wave guide in which a microwave field is set up to do the drying. The wave guide is a six-foot-long rectangular box with a slot in it to permit the print to be drawn through the microwave field.

Dr. G. A. Miller, head of the section, said the microwave field generates heat in the moisture on the print and not in the fibre of the print. Thus, the fibre of the print is not damaged by heat. The water on the print is brought to boiling point and leaves the print as steam, which is removed from the wave guide by suction provided by a slow-speed centrifugal blower.

Main advantages of the machine are drying speed and fine control. An operator can run a print through at various speeds and control the amount of moisture he wants to remain in the print.

The machine is expected to find widespread use in the drying of prints 40 inches wide and from 10 to 12 feet long. Prints of this type, which are used in making large photographic murals, can be dried in 10 to 15 minutes.

Previously such prints took up to a day to dry. They had to be spread on drying room floors, taking up many feet of floor space.

Dr. Miller said the machine also promises to be of major value in the drying of large color prints, which cannot be dried with heat because this process changes colors.

However, with the present machine the conveyor belt leaves a pattern in the soft emulsion on the color print. This problem is expected to be solved by using an endless fine-weave dacron belt.

The dryer has also been used successfully for drying leather sheets less than one-eighth of an inch thick. Other applications being investigated include the drying of silk screen reproductions of paintings, plywood and paper

NRC Role in Alouette II

A National Research Council instrument package aboard Canada's Alouette II satellite is studying what scientists regard as the most interesting unsolved mysteries of the Van Allen radiation belts.

Alouette II, Canada's second satellite, was launched into orbit Monday, Nov. 30, by a Thor-Agena B rocket from the Vandenberg Air Force Base in California. It is circling the earth in an elliptical polar orbit ranging in altitude from 312 to 1,850 miles.

The 326-pound satellite is the second in a series to be launched jointly between now and 1970 by Canada's Defence Research Board and the United States National Aeronautics and Space Administration.

The main purpose of Canada's satellites is to study the ionosphere from above. Radio waves of different frequencies are transmitted from the satellites and the time is measured that it takes the reflected waves from the ionosphere below to return to the satellite.

In addition to this experiment — referred to as a topside sounder — Alouette II contains experiments to study galactic radio noise, very low frequency radio wave emissions, local electron densities and temperatures and NRC's experiment to study cosmic rays and the charged particles in the Van Allen radiation belts.

Within hours after the launch of Alouette II, Dr. D. C. Rose, head of the cosmic rays and high energy particle section of NRC's Division of Pure Physics, reported that the seven different charged particle counters in the NRC package were functioning smoothly.

Dr. Rose, chairman of NRC's Associate Committee on Space Research, said signals from the counters will be received by telemetry equipment in Ottawa, Resolute Bay in the Northwest Territories, St. John's, Nfld., and at 12 other stations in various parts of the world.

The Van Allen belts consist of magnetically trapped particles in the upper atmosphere. Disturbances in these belts dump particles into the atmosphere which cause serious communications blackouts.

New Flag Goes Aloft

The NRC counters will provide data which will aid in the understanding of the mechanisms responsible for the production and control of the Van Allen radiation zone particles, and the related problems of entry into the earth's magnetic field of solar and cosmic ray particles. They also will provide data on the general distortions of the earth's field which occur when there are changes in the strength of the solar wind, a stream of low-energy particles emitted by the sun which greatly distorts the earth's magnetic field at distances from the earth of the order of 35,000 miles.

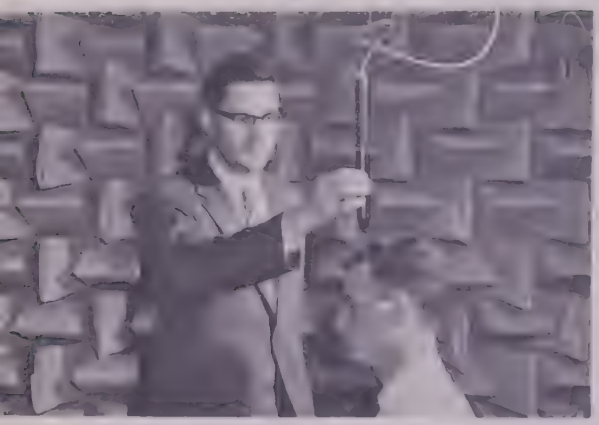
"It is almost certain that the source of the energy for most of the electrons and protons in the Van Allen radiation belts, as well as for the particles that produce aurora, is the solar wind," said Dr. I. B. McDiarmid, who is associated with Dr. Rose in the NRC experiment.

"However, the energies of these particles are much greater than the energies of individual particles in the solar wind, so that particle acceleration must take place somewhere in the earth's magnetic field. Although this acceleration mechanism is likely driven by the solar wind, just what it is and where in the earth's field it operates are probably the most interesting unsolved problems concerning the radiation belts at present."

The NRC package contains electronic circuitry to amplify and count the detector pulses and to arrange the signals in a format that is suitable for transmission to earth. When the telemetered signals are received on the ground they are automatically put in a form which is suitable for processing in a computer.

Alouette II's NRC Instrument Package.

Probe Microphone



Dr. Shaw demonstrates the use of the probe microphone for measuring the sound pressure level inside the ear of acoustic technician Allan Hellard.

A National Research Council scientist has made a significant advance in the technology of probe microphones used for precise measurements of sound in hard-to-get-at places.

The advance, made by Dr. E. A. G. Shaw of the acoustics section of NRC's Division of Applied Physics, has resulted in the development of a new probe microphone which should find wide application in sound measurement.

Probe microphones have been in use for some 30 years. Most of them were developed by individual users to suit particular experiments. As a result, the technology of probe microphones never developed to a point where a multi-purpose instrument could be built.

The main problem in the development of a multi-purpose probe microphone was to produce an instrument which does not suffer from very poor sensitivity at high frequencies (weakness in sound pickup) and uneven frequency response.

Dr. Shaw overcame this problem by inserting an acoustic horn between a narrow probe tube and a half-inch diameter condenser microphone which converts sound into an electrical signal. The horn is a specially tapered tube, the small end of which is coupled to the probe tube and the large end to the microphone. It serves as an acoustic transformer which improves the efficiency with which high frequency sound is transmitted to the microphone. Special acoustic resistance elements placed in the probe tube and near the large end of the horn ensure smooth transmission of sound over a wide range of frequencies.

"The new probe microphone will do a job better than most home-made instruments designed for specific purposes," Dr. Shaw said. "We have taken the probe microphone out of the home-made instrument field and placed it in the modern highly-sophisticated instrument field."

A licence for the manufacture of the instrument has been granted by Canadian Patents and Development Limited, a subsidiary of NRC, to Muirhead Instruments Limited of Stratford, Ontario. It is being marketed under the trade name Muirhead Probe Microphone.

The microphone can be used for applications such as the control of hearing threshold determinations and other psycho-acoustic experiments; the standardization of audiometer earphones; the measurement of real ear frequency response of earphones; measurement of the physical attenuation (sound exclusion) of cover type ear defenders on real heads; the investigation of machinery noise; the inspection of mechanisms by operating noise level; acoustical studies of traditional musical instruments; acoustical analysis of electro-acoustical devices; acoustic filter design and the analysis of the acoustic characteristics of building models.

Dr. Shaw said the design of the acoustic resistance elements was a prime example of the type of technology that had to be developed. These elements, measuring one millimetre in diameter, are made of stainless steel cloth (woven mesh) with each element containing some 200 holes.

NRC research news

MAY-JUNE, 1965

LIBRARY

Seeing in the Rain—page 11

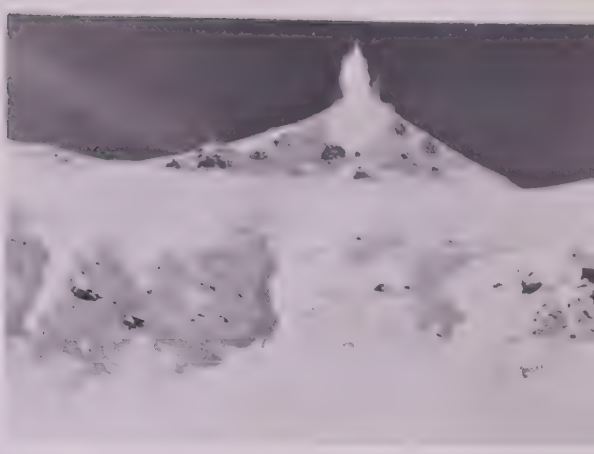
Vol. 18, No. 3, May-June, 1965. Published by the Public Relations Office, National Research Council, Ottawa. *Material may be reproduced with or without credit to NRC Research News unless a copyright is specifically indicated.*

Man-Made Avalanche	3
Life of CF-100 Doubled	4
Dunn Guarded Voltage Divider	6
Memory Learning Task	7
Shah of Iran	8
Extract	8
Awards — Appointments	9
NRC's Blind Scientist	10
Rain Repellent Perfected	11
Shipping Study	14
Churchill Rocket Range	16
Building Code Gains Acceptance	16

Cover Photo: Water spraying from nozzles mounted on the front of an automobile obliterates vision on untreated side of the windshield during a demonstration of Dr. Stedman's rain repellent. The treated side gave the driver unrestricted vision without the use of windshield wipers.

Photo Credits: Cover by Capital Press; Dr. McCormack by Capital Press; Shah of Iran by Dominion-Wide; CF-100 by RCAF and NFB; freighter by St. Lawrence Seaway Authority; others by NRC.

Man-Made Avalanche



Blasting ice cornice on Alberta's Eagle Peak near Lake Louise.

A joint study is being made by an NRC-McGill University team to learn conditions that create avalanches and factors that contribute to their destructive power.

The present Canadian program of avalanche protection is based on work by the Division of Building Research. The new study, arising from this previous work, may give scientists and engineers the information they need to design new, more effective defences against avalanches and pinpoint locations where avalanches are likely to occur.

Initial research on the new study started in Banff National Park in February five days after an avalanche killed 14 men and injured 20 at the Granduc Copper Mines camp near Stewart, B.C. The research will be continued next winter.

The NRC-McGill team created an avalanche on 9,000-foot Eagle Peak, some seven miles east of Lake Louise, by blasting away a piece of the peak's ice cornice with 50 sticks of dynamite.

Previous avalanche studies were conducted with movie cameras and by on-the-spot observations. These methods do not give scientists the information they need to analyze avalanches and propose defences.

The avalanche created by the team is being studied by photogrammetry, a highly refined technique for making precise measurements from photographs.

Two modified aerial survey cameras were positioned 400 feet apart on a slight rise about 1,700 feet from the top of Eagle Peak. Photographs were taken every one-and-one-half seconds by the cameras during the avalanche's 45-second plunge down the mountainside.

The cameras were perfectly synchronized, allowing them to take photographs simultaneously. These photographs are being used to create a precise three-dimensional optical model of the avalanche from which exact measurements of the actual avalanche are taken.

The accuracy of measurements is of the order of 10 microns or one two-hundred-fiftieth of an inch. In terms of the avalanche, measurements of what took place are within an accuracy of a few inches.

The analysis of the photographs is made with the aid of a precise plotter. A series of picture pairs are printed on glass and oriented on the plotter to produce the three-dimensional optical model. With the model it's possible to examine the avalanche at each stage of its progression down the mountainside.

The team hopes that the information obtained by this photogrammetric method will give them increased knowledge of avalanche formation and the factors that contribute to their destructive power. It might then be possible to design more effective means of protection.

The project was planned by T. J. Blachut, head of the photogrammetric section of NRC's Division of Applied Physics and Dr. Marcel Kahn, an NRC post-doctoral fellow from France doing research at McGill University. NRC photogrammetrists M. C. van Wijk and J. G. Lempereur participated in the field tests and final evaluation of results.

Mr. Blachut said the February experiment provided valuable information and will be particularly useful in planning next year's expanded field operation.

Life of CF-100 Doubled

RCAF CF-100 can be safely flown for 4,000 hours.

Engineers at NRC have torn an RCAF CF-100 fighter to pieces and proved that this aircraft's life can be doubled.

Dismembering of the twin-engine aircraft — down even to an X-ray examination of its rivets — was done by the structures section of NRC's National Aeronautical Establishment.

The CF-100 was built originally as an interceptor fighter and saw extended service in this role in Canada and overseas. It now has been replaced by other types of jet aircraft.

In April, 1964, the RCAF asked N.A.E. to conduct a fatigue test on the entire airframe of a CF-100 in an effort to effect a major economy by keeping this aircraft in service.

The objective of the test was to determine by means of simulated flight conditions whether the CF-100 could be safely flown for more than 2,000 hours, its generally accepted operational lifespan.

This 2,000 hours of operational life was projected several years after the aircraft went into service. At the time it was built little was known about aircraft fatigue and it is only in recent years that it has been possible by fatigue testing to assess accurately an aircraft's operational lifespan.

The seven-month study proved that the CF-100 can be used for an additional 2,000 hours, or a total of 4,000 hours, without jeopardizing flight safety or airworthiness. Structural failures of a serious nature did not start to appear until the aircraft had completed 20,000 hours of simulated flight.

The study was conducted over 20,000 hours because the properties of materials used in aircraft and quality of workmanship vary from plane to plane. This gave assurance (a safety factor of five to one) that the plane would not fail under all expected conditions it would experience if flown for 4,000 hours.

At the present time the air force has a number of CF-100's in various stages of readiness at air stations at Trenton, Ont., St. Hubert, Que., and Lethbridge, Alta.

An air force spokesman said a number of planes will continue to be used for several more years for reconnaissance, training and other purposes. After a decision has been made on the number of aircraft to be retained, the others will be disposed of to save storage costs.

The airframe of the CF-100 was tested under all possible conditions of flight, including the worst. These included take-

2g, regular flight, steep pullups, rolls and other stress producing flight patterns and heavy landings.

Specially-built hydraulic equipment was used to subject the airframe to the flight stresses and strains it would encounter under these maneuvers. The applied loads were controlled and recorded with electronic equipment. This test equipment now will be available for other projects of this nature.

A particular feature of the equipment was that it permitted a variable rate of loading, enabling 20,000 flight hours to be completed in seven months at a rate of about 250 hours a day. Without this feature, the test would have taken 3½ years using conventional equipment.

During the course of the test, the airframe was inspected regularly to simulate service inspections. Minor fatigue failures similar to those found in CF-100's which had actually flown a similar number of hours were detected.

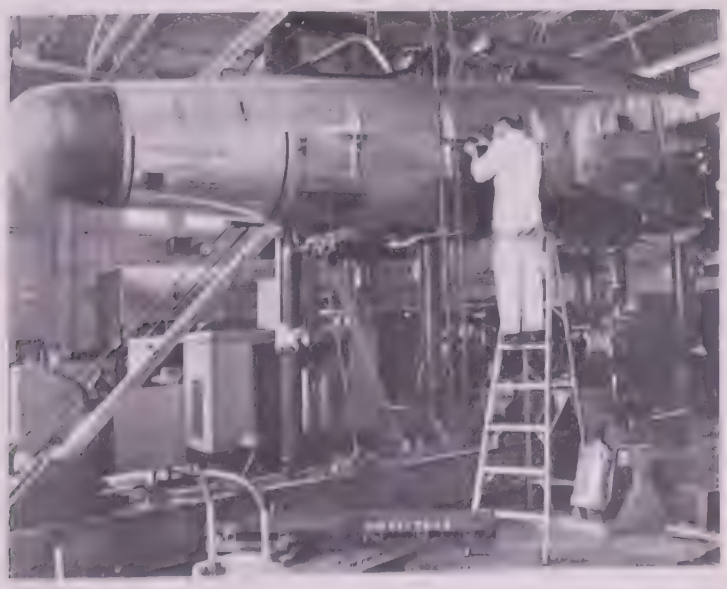
A crew of six air force technicians from No. 6 Repair Depot at Trenton assisted in running the test. A second crew of metal workers from the Central Experimental and Proving Establishment at Uplands Airport repaired the airframe after each failure in accordance with RCAF practice under actual service conditions. This assistance by the air force made it possible for N.A.E. staff to maintain a 24 hour shift for the test.

The final failure was a catastrophic separation of the wings, which in service would have led to complete destruction of the aircraft.

However, as a result of the test, the air force now is in a position to plan a program of inspection for the aircraft it intends to keep in service. It will have advance knowledge of the kind of failures to watch for and can also plan a program of maintenance to avert such failures.

Following completion of the fatigue test, the airframe was examined with X-ray equipment to ensure that no invisible failures had escaped detection.

The fatigue test was conducted by J. A. Dunsby, senior research officer of the structures section, and directed by A. H. Hall, head of the section. Dr. H. F. L. Pinkney was responsible for the instrumentation and loading systems and R. T. Sewell was in charge of load and stress analysis.



CF-100 undergoing fatigue test at NRC.

Dunn Guarded Voltage Divider

An NRC scientist has developed a new instrument for measuring electrical voltages of up to 2,000-3,000 volts more accurately and quickly.

Designed by Dr. A. F. Dunn, a member of the electricity section of the Division of Applied Physics, the instrument also can be used for better calibration of voltage dividers used in association with potentiometers for measuring voltages in this range.

Development of the new instrument — known as a Dunn Guarded Voltage Divider — followed the acceptance of a challenge given to Dr. Dunn in February of 1964.

Dr. Dunn delivered a paper on "Measurement of Voltage Ratios" at a symposium sponsored by the United States Army Missile Command at Redstone Arsenal, Alabama. In the paper he was critical of the accuracy of voltage dividers on the market at that time and suggested they could be improved.

A representative of Guildline Instruments Limited of Smiths Falls, Ont., attending the meeting told Dr. Dunn to design a new instrument and his company would produce it. Dr. Dunn did just that and the Dunn Guarded Voltage Divider now is being produced by Guildline.

The method of measuring higher voltages criticized by Dr. Dunn involves the use of a voltage divider to reduce the high voltage to a level of between one and two volts which is then measured with an associated potentiometer.

The trouble with this system is that many of the voltage dividers used lose their accuracy as they are heated by electricity passing through them. This can change the ratio of voltage reduction and the potentiometer gives an inaccurate reading of the voltage applied to the voltage divider.

Two methods are used in Dr. Dunn's new instrument to overcome this heating problem.

The instrument is contained in an oil bath and the oil is heated to keep it slightly above room temperature. This eliminates self-heating effects as long as the oil is well circulated.

New instrument for measuring higher voltages.

A system of electrical shielding used in the instrument eliminates electrical insulation failures, or high voltage arcing, which has bothered other styles of instruments. In addition, the use of copper connection terminals helps to reduce the adverse effects of heating.

Dr. Dunn said the new instrument can be connected directly to a power source of 2,000 to 3,000 volts. In this capacity it can act both as a voltage divider and a potentiometer.

"We thus have a very compact instrument capable of replacing a voltage divider and a potentiometer," he said. "It is hoped that industry and laboratories will start using it as a high voltage potentiometer."

The instrument will fill another important role in that it can be used for the rapid, accurate calibration of voltage dividers now in use in factories and laboratories.

"In this role the new instrument will ensure that voltage dividers now in use are performing properly," Dr. Dunn said. "It will be a back-up instrument to enable factories and laboratories to have the assurance that the voltages they are working with are accurate."

The instrument now being produced by Guildline sells for about $3,500 in Canada and $4,500 in the United States.

Learning In Two Phases? ?

A $4,300 NRC grant awarded to Dr. Peter D. McCormack, associate professor of psychology at Carleton University, Ottawa, is being used in a study of the relationship between eye movements and learning verbally by memorizing. Basic research is being done at the Carleton campus (with sophomore psychology students acting as subjects) in the hope of substantiating the theory that learning goes on in two phases.

Seven pairs of nonsense syllables provide the "data" for the subjects performing a memory learning task. These syllables, scaled for meaningfulness, are flashed on a screen by a projector at consecutive two-second intervals.

For example, the syllable "RIX" is flashed on the screen alone. Then the syllables "RIX" and "TEB" are flashed side by side.

When the syllable "RIX" next is flashed alone, the subject is required to recall and confirm verbally the syllable which appeared on the screen with "RIX" — in this case "TEB".

In the experiments "RIX" is called the stimulus and "TEB" the response.

The subject is seated in front of the screen with a small motion picture camera mounted on his head. An optical periscope attached to the head gear, which holds the camera, reflects a bright spot of light off the front of the eye's cornea into the camera as it records eye movements during the learning process. This makes it possible to determine where the eye is focussed when both syllables are flashed on the screen.

Results based on six months' research with two groups of 20 students corrobarate the two-phase learning theory. During early trials, the focal point was consistently on the reponse "TEB," rather than on the stimulus syllable "RIX", thus the first phase of learning — response consolidation. During the later trials the prime focal point became the stimulus, hence, phase two — the stimulus response hook-up.

As learning progressed, proportionally less and less time was spent viewing the response when stimulus and response were presented together.

Dr. McCormack demonstrates his experiment.

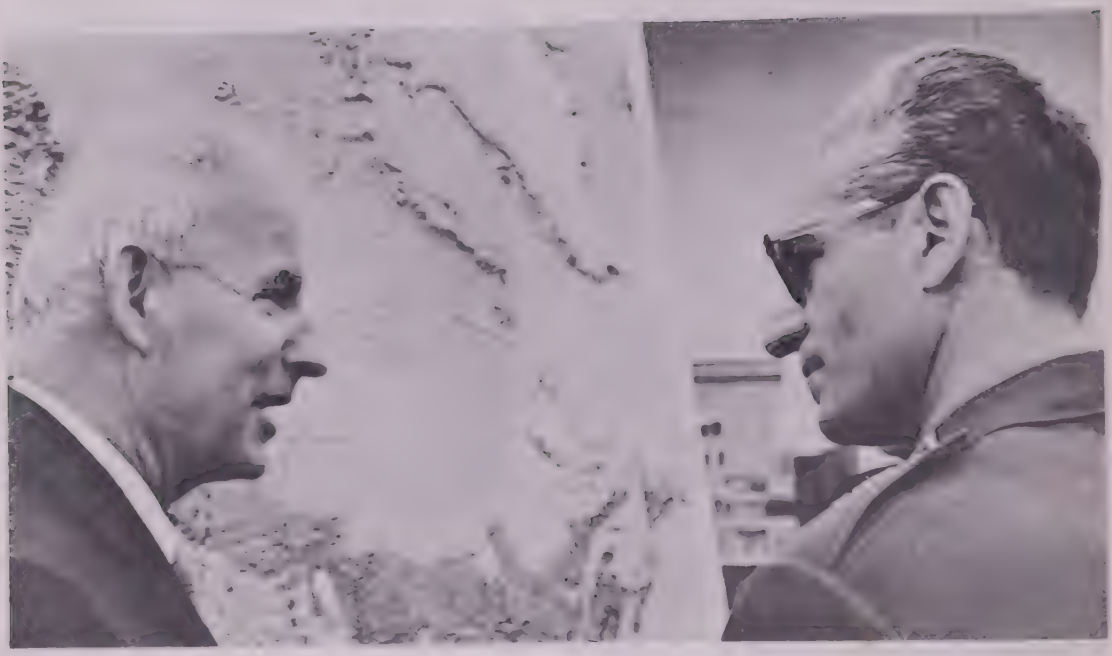
It was also noted (when the groups were divided into fast and slow learners) that the focal point of fast learners moved to the stimulus sooner than with slow learners, that is fast learners moved to phase two of the learning process more quickly than did slow learners.

Subjects were not tested in any way prior to the experiment. Only those who cannot learn this type of list ("I know a PhD who fits into this category," Dr. McCormack commented) or those whose cornea is shaped so as to be virtually impossible to photograph, need be disqualified.

Though all subjects up to this point have been Carleton students, Dr. McCormack hopes, during the summer, to photograph the eye movements of deaf and dumb children as they are lip reading. It is from this phase of the research that practical results could be derived.

"It will take two or three years before the equipment and techniques are perfected, though," Dr. McCormack explained. "We want to make sure the theory is as good as it looks now so that in later years some kind of predictions can be made."

Shah of Iran at NRC



Dr. D. C. MacPhail, director of NRC's Division of Mechanical Engineering, greets the Shah of Iran during His Majesty's visit to NRC in May.

Extract

Present popular tendency is to suggest that we should put science to work to solve the problems we know about. But the great breakthroughs which made our present civilization possible were not the result of solving problems that we knew about, but rather by learning the secrets of nature which made possible the solutions.

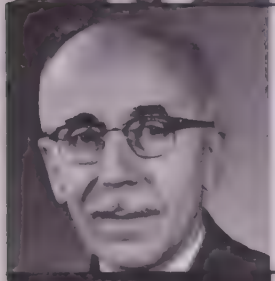
Even the simpler devices which civilization has produced were only effective when the science back of them was understood. The steam engine was an operating novelty long before it became a practical work horse, and it became practical only after we understood the laws of thermodynamics involved and were able to operate it with a reasonable economy of fuel.

No one was able to build an atomic power plant until the nature of the atom was understood, until we knew something about the energy required for splitting the atom. The transistor became a practical unit only after the laws of solid state physics had been promulgated.

I have dwelt on this matter because I want to emphasize the importance of fundamental research, and we should beware of any attempt to concentrate our efforts on the solution of problems rather than seeking the great truths of nature of which we still are ignorant. Nevertheless, we do need applied research also to exploit these scientific breakthroughs.

— *Dr. B. G. Ballard, president of NRC, speaking to the Ontario Chamber of Commerce at London, Ont., May 18, 1965.*

Dr. B. G. Ballard, president of NRC, awarded the Sir John Kennedy Medal for 1964 by the Engineering Institute of Canada. Dr. Ballard also received an Honorary Doctorate of Law degree from the University of Victoria.



Dr. Léo Marion, Vice-President (Scientific) of NRC, resigned to become Dean of the Faculty of Pure and Applied Science of the University of Ottawa. Dr. Marion also received an Honorary Doctorate of Science degree from the Royal Military College.

Dr. Gerhard Herzberg, director of NRC's Division of Pure Physics, elected a Foreign Honorary Member of the American Academy of Arts and Sciences. He also received an Honorary Doctorate of Science degree from Queen's University.

Dr. Elwyn Hughes, Scientific Attaché at the Canadian Embassy in Washington, named Executive Secretary of the Federal Government's new Scientific Secretariat in the Privy Council Office.

Dr. J. M. Roxburgh, NRC's Ottawa Liaison Officer, succeeded Dr. Hughes in the Washington post. Dr. David I. R. Low, a member of the chemical engineering section of the Division of Applied Chemistry, succeeded Dr. Roxburgh.

Dr. Leo Charles Vining, head of the Biochemistry and Microbiology Section of NRC's Atlantic Regional Laboratory, Halifax, received the Merck Sharp & Dohme Lecture Award of the Chemical Institute of Canada.

NRC's Blind Scientist

James Swail, Canada's only working blind scientist, has produced a long list of inventions to aid the blind — and one of them was mistaken for a time bomb.

The 39-year-old NRC electronics expert mailed the invention to Prof. T. A. Benham, Director of Science for the Blind in Philadelphia.

In the middle of the night Prof. Benham was informed by telephone that Philadelphia Police had seized a strange ticking parcel addressed to him.

But there was no need for concern. An anti-bomb squad was standing by to disarm the package.

Prof. Benham asked for the name of the sender. When he was told it was Jim Swail of Ottawa, he replied:

"That's no time bomb — that's a continuity checker, an instrument for checking electrical continuity."

Mr. Swail, blind since early childhood, graduated with a Bachelor of Science degree from Montreal's McGill University in 1946, with majors in mathematics and physics. He took all his notes in Braille during his university studies and relied on his classmates to read to him.

"The blind students of today are very fortunate to have the use of tape recorders," Mr. Swail says. "In my days at McGill this extremely helpful aid was non-existent."

After graduation, Mr. Swail joined the navigation aids section of NRC's Radio and Electrical Engineering Division. At first he worked on special electronic instruments to help him conduct his own research.

He joined the division's instrument section in 1951 where he has developed specialized electronic equipment. The instruments he has developed to aid the blind are distributed internationally by the Philadelphia organization headed by Prof. Benham.

The Swail Dot Inverter, now in production in the United States, is revolutionizing the production of Braille drawings by hand.

In producing Braille drawings a pointed instrument is used to produce characters by punching holes through paper. The raised dots forming the characters come out on the underside of the paper, meaning that Braille must be produced in reverse.

However, the new inverter raises the dots on the upper side of the paper, eliminating the reversal process. A Brantford, Ont., school now is acquiring the inverter, which will be useful in many branches of teaching.

Mr. Swail is working on a four-section collapsible white cane for the blind, which will be completely rigid in use. The cane is four feet long and can be collapsed in seconds and placed in a blind person's pocket.

Mr. Swail also is the inventor of a thermometer which can be "read" by the blind and an auditory beacon which emits a "beep" every 10 seconds.

The beacon can be a valuable aid for a blind person interested in being active. If a blind person is cutting the lawn and has to answer his telephone, he turns on the beacon and drops it beside his mower. After completing his phone call, he has no difficulty in locating the mower and continuing the job.

Mr. Swail demonstrates his weigh scale for the blind.

Seeing In The Rain

An illustration of how water beads or ripples give false view (centre) of horizon.

A repellent that sheds rainwater from the windshields of aircraft and automobiles, giving pilots and motorists nearly perfect vision, has at last been perfected by a Canadian scientist after 24 years of research.

It will help prevent aircraft accidents caused by a pilot's vision being obscured or distorted by rain striking his windshield, and improve a motorist's ability to see during heavy downpours.

An early version of the repellent, a complicated silicon compound, was first produced some 20 years ago by Dr. D. F. Stedman of NRC's Division of Applied Chemistry.

This repellent and later improved versions of it worked. But like so many things in this world, each of these versions had small but serious difficulties and research in each case ultimately reached a dead end with some points not solved, Dr. Stedman said.

However, after a month or two, or a year or two, other attacks seemed promising and the search was started again and Dr. Stedman's research finally reached a successful conclusion just this March.

"All the difficulties have been licked," he said. "The repellent is not now a 'version'. I now am completely satisfied with it. It's easy to use and does all the things a rain repellent should do."

Patents have been applied for by Canadian Patents and Development Limited, a subsidary of NRC. This company now is looking for a manufacturer.

Rain on the windshield of an aircraft causes two basic vision difficulties:

1. General blur, making small things disappear and large things very fuzzy. This can be so bad that the windshield looks much like a sheet of white paper.

2. Even when vision in rain may be fairly good the water on the windshield acts like a prism and makes the ground and horizon look much lower than it really is. The pilot thinks he has plenty of clearance when this is not the case.

Both of these visual difficulties can cause serious aircraft accidents. Planes flying in rain are in danger of crashing into other aircraft and at low altitudes into trees, power lines, flag poles and even tall buildings since such objects may not be visible to a pilot flying without rain repellent. Water on a windshield also prevents a pilot from seeing the horizon at its true level, and the plane may then be in danger of plowing into peaks, cliffs or mountains or striking the ground on take-off or landing.

Dr. Stedman reports that statistical examination of hundreds of aircraft accidents shows that (excluding training accidents) about one half of them involve rain as a contributing factor, making rain the most serious single hazard in aircraft operation.

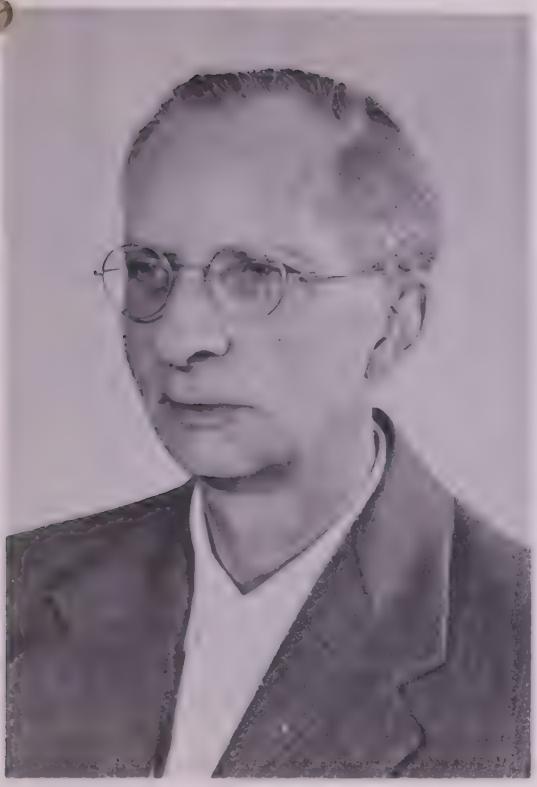
Accidents in which visual errors in rain are a major factor unfortunately occur with considerable regularity all over the world. But this particular hazard now need not occur, Dr. Stedman said.

When the repellent is used on an aircraft windshield even the heaviest rain looks like tiny grains of pepper striking the glass and being blown away in the plane's slipstream. Vision is obscured so little that objects as small as power lines or flagpoles are quite clear and the horizon level is true and undistorted.

The repellent is not quite as effective on automobiles since the wind speed is less. But even when driving in heavy rain without windshield wipers, the water jumps off the glass in little jets and provides safe vision at any speed, although wipers do improve vision with the repellent. Headlight glare from approaching traffic is also reduced by the repellent, especially in heavy rain.

This repellent, called S.P.R. (Semi-Permanent Repellent) looks much like black shoe paste and is a trick compound.

Effect of repellent is shown in this wind tunnel test. Centre smudged area of glass was not treated.



Dr. D. F. Stedman

It is not itself particularly adhesive to glass but it is decomposed by friction and the broken molecules combine with the glass chemically and actually become part of its surface, accounting for its remarkable adhesion and long effective life. A little of this black paste rubbed briskly on glass and polished works up to a slippery coating that sheds water like the proverbial duck's back and it retains this quality for weeks or even months although the coating is only about one ten-millionth of an inch thick.

Asked about the durability of such a thin coating, Dr. Stedman said that in the development of the repellent there were several instances where it was effective on aircraft three or four months after it had been applied. It still provided adequate vision for safety when these aircraft happened to fly into rain so heavy that there was no vision whatever on untreated parts of the windshield.

Dr. Stedman last September applied the repellent to the windshield of his automobile. It was effective until mid-April, despite sand, mud, salt and all the other indignities to which windshields are subjected.

Long neglect of this nature is not recommended. To keep the repellent in top condition it should be reapplied every week or two.

Motor vehicles and perhaps aircraft would still be provided with windshield wipers. Although they are not strictly needed, they do help vision and help to remove dirt.

However, on aircraft the rain repellent provides such excellent vision at all airspeeds and in all rain densities that air blast spoilers producing vortices up the windshield or other complexities using engine power or even wipers will not be required.

Dr. Stedman in his laboratory during early research work.

Shipping Study

Lake carriers like this may carry more cargo.

A study to determine whether shipping companies can operate more economically along the Canadian east coast, the Gulf of St. Lawrence and the Great Lakes has been started by NRC.

It's designed to show whether freighters, particularly bulk carriers now plying these waters, are capable of carrying greater cargo tonnages than presently authorized, provided they have sufficient depth of water in which to operate. It also will show whether ships planned for the future for the three waterways can be built more economically and perhaps longer.

A sufficient increase in the volume and speed of moving grain, iron ore and other commodities could bring about some reduction in the cost of transporting such goods.

The research project is being conducted by the hydraulics and ship sections of NRC's Division of Mechanical Engineering. Support is being provided by the Department of Transport, the United States Coast Guard, the Bedford Institute of Oceanography and the marine sciences branch of the Department of Mines and Technical surveys.

The hydraulics laboratory's job is to learn what kind of waves a ship will have to cope with on the three waterways during her operational life. The ship section will determine the strength a ship's hull must have to withstand the stresses produced by these waves.

This information is required by the marine regulations branch of the Department of Transport in connection with suggested revisions to load line regulations to permit ships to carry greater tonnages.

The research represents a new approach in the adoption of design criteria for ships that is related directly to the wave stresses they will encounter. Up to now these criteria have been based mainly on statistics and experience gained in the operation of ships over many years.

Work by hydraulic scientists started in April on Lake Superior and will be continued next year in the Gulf and eventually in east coast waters.

The laboratory will make simultaneous recordings of wind velocities and wave heights at different locations. This information will be used to relate wave heights to wind velocities.

One of the buoys being used in the study.

Once this relationship has been established, it will be possible, with the use of wind records dating back some 10 years, to forecast what kind of waves can be expected on the lake with a known frequency of occurrence.

The ship laboratory scientists will study how much hull bending is caused by various types of waves under different conditions of load. Simultaneously, free-floating buoys will be used to measure the heights of waves causing these strains to ships' hulls.

The two types of information will enable marine engineers and architects to determine an optimum (most favorable) design for freighters plying the Great Lakes and the other waters.

It's expected that the research will show whether ships now in service have been overdesigned — and hence built at too great a cost — for the cargoes they are permitted to carry.

If they have been overdesigned and are more than capable of withstanding sea conditions in the three waterways, they could carry more cargo safely, provided they have sufficient water in which to operate. Instead of making eight trips to carry a given amount of cargo, this might be done in seven or fewer voyages.

New vessels would be less expensive if they are not overdesigned for the cargoes they are to carry. Scientists also will be able to determine whether new ships can be built longer to increase their cargo capacity. It may be possible to build lakers up to 1,000 feet in length for some routes, compared with a present maximum length of just over 700 feet.

Wave measurements by hydraulic scientists will be made with electronic recorders installed in anchored buoys floating some 10 miles offshore. This information will be transmitted by radio to shore stations where it will be recorded on tape.

With the aid of an electronic computer, the information later will be compared with wind speeds to obtain data on the kind of waves that can be expected on the lake with a known frequency of occurrence.

Stresses caused to the hulls of ships by wave action will be measured this year with strain gauges attached to the hulls of three Canadian vessels, the Seaway Queen, Saguenay and Cape Breton Miner.

Dr. R. S. Rettie, 47, head of the Satellite Tracking Group of the Radio and Electrical Engineering Division has been appointed Chief of the Churchill Research Range Branch of NRC.

In this post Dr. Rettie will be stationed in Ottawa and will report to Dr. K. F. Tupper, Vice-President (Scientific) of NRC who will be in charge of this new council operation at Fort Churchill, Man.

Dr. James H. Brandy, 43, Officer in Charge of the Defence Research Board's Northern Laboratory at Churchill, has been appointed officer in charge of the range.

Under a new Canada-United States agreement the range will be gradually turned over to NRC by the United States Air Force, the transition being completed by the end of 1965. For the next six months Pan-American Airways will continue to operate the range under contract with USAF. Pan-American will then operate the range under contract with NRC.

NBC

NATIONAL BUILDING CODE OF CANADA

Canadian municipalities are accepting the National Building Code of Canada with increasing rapidity.

The Associate Committee on the National Building Code, National Research Council, reports that a survey on the use of the Code completed December 31, 1964, shows that 85 per cent of Canadian cities now are following the Code.

The committee's report was based on returns received after a questionnaire was sent to more than 1,600 municipalities. It is a reasonable guide in assessing the momentum the Code is gaining across Canada.

The survey showed that 138 of Canada's 161 cities are following the Code in whole or in part in local building regulations. This is an increase of 22 cities since the last survey in 1962.

The 138 cities, based on the 1961 census, have a total population of 7,319,076 which is 92.6 per cent of the population of the 161 cities.

At December 31, 1964, 64.5 per cent of Canadians lived in cities, towns, villages and other localities where the Code is used. This compares with 37.4 per cent at February 28, 1959, 41 per cent at February 29, 1960, and 53.7 per cent at December 31, 1962.

Of Canada's 664 towns, a total of 335 use the Code. These towns have a total population of 1,590,916 which is 65 per cent of the population of the 664 towns.

Of the 1,135 villages listed in the 1961 census, a total of 256 use the Code and they account for 30.7 per cent of the population of all villages. However, a considerable number of villages do not have local building bylaws and therefore the figure of 30.7 per cent is understandably low.

LIBRARY

NRC research news

SEPTEMBER - OCTOBER, 1965

Extending Storage Life of Vegetables page 4

Vol. 18, No. 4, September-October, 1965. Published by the Public Relations Office, National Research Council, Ottawa. *Material may be reproduced with or without credit to NRC Research News unless a copyright is specifically indicated.*

Electric Model Heart	3
Unique New Colorimeter	4
Appointments — Awards	5
New Life For Stored Vegetables	6
NRC at the CNE	8
New Atomic Clock	10
All-Tide, All-Weather Harbor	12
University of Manitoba Dental School	13
Bird Strikes	14
Traffic Noise	16

Cover Photo: Bert van den Berg of the Food Technology Section of NRC's Division of Biosciences examines carrots which have been stored for nine months in a low temperature-high humidity environment.

Photo Credits: Cover by R. H. Whitehead, Division of Biosciences, NRC; Prime Minister Lester B. Pearson and His Excellency S. P. O. Kumi, Ghanian High Commissioner to Canada, by Alexandra Studio, Weston, Ont.; NRC at CNE by Gilbert A. Milne, Toronto; University of Manitoba Dental School by Jack Ablett, Winnipeg Free Press; Dr. G. Malcolm Brown by Wallace R. Berry; Traffic Noise Cartoon and other photos by NRC.

Electric Model Heart

The electric model heart is shown in the upper right hand corner of the photo. Recording equipment to the left.

An electric model heart has been built at NRC. It is designed to reproduce all the electrical activity of the normal heart and has been made by the Instruments Section of the Radio and Electrical Engineering Division.

Fitted into a simulated human torso in the place occupied by the real heart, the device makes it possible to measure the effectiveness of electrocardiographs which are intended to monitor the electrical activity of the heart.

The model heart was developed specifically to study the effectiveness of a sophisticated type of electrocardiograph built at NRC and called the area display ECG.

This machine functions much like a miniature televison station. Some 70 electrodes, placed around the chest, pick up electrical signals from the heart and transpose them into signals that can be televised and then photographed.

With the machine it is actually possible to see and photograph the results of a heart attack in a living heart. It has received encouraging evaluation results at Queen's University at Kingston, Ont., where it has been tested.

The new electric heart model may be of use, not only in testing this particular ECG machine, but also to give more exact assessment of the effectiveness of any of the multitude of different types of ECG lead systems now available.

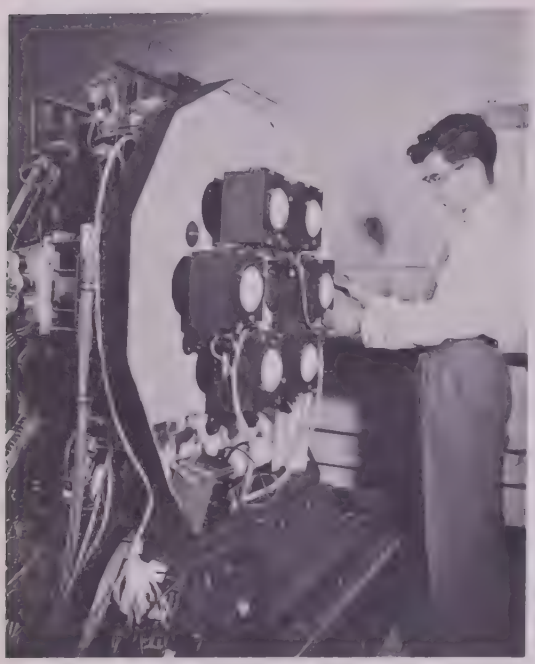
So far, electric heart models have mostly used simulated heart energy, but this one reproduces electrical energy put out by a real heart.

A normal heart beat is tape-recorded and the magnetic record on the tape is "played back" in the form of electrical energy.

O. Z. Roy, who developed the electric heart model, said the next step will be to tape record a variety of diseased hearts in order that comparative records can be made of the effectiveness of ECG's monitoring of various heart problems.

Studies made so far indicate the artificial electric heart reproduces closely the actual activity of the human heart.

New Color Study at NRC



Graham Fielder, Technical Officer with the Radiation Optics Section of NRC's Division of Applied Physics, examines new colorimeter.

A unique electronic colorimeter has been designed and built by the National Research Council to answer many basic questions of industrial color control problems.

Exact colors are important in the textile and paint industries and in such widely divergent industries as agriculture, mining, electronics and plastics. The essence of mass production is interchangeable parts and this requires that every part made for a particular product must be exactly the same color or within a specified tolerance of the true color.

For some decades scientists have been measuring colors with various types of colorimeters. As a result of this work a number of color chart systems have been developed as guides to industry for color selection.

These chart systems show anywhere from 1,000 to 2,000 different colors. Their main defect is that the differences between colors are not uniform. This lack of uniformity makes it difficult to specify the degree to which a color for a particular product may be off the selected color and still be acceptable.

The ideal color chart would be one in which differences between neighboring colors are just perceptible and where these differences are uniform. However, if this were carried out for the whole universe of colors as many as 10,000,000 different colors would be required to represent what is known as color space.

Color space, therefore, must be represented by colors which are much more widely spaced than just by perceptible differences. The reduced number of colors must also be spaced uniformly as to visual perception.

The new colorimeter, designed by Dr. Gunter Wyszecki, head of the Radiation Optics Section of NRC's Division of Applied Physics, is being used to determine whether such a uniform representation of color space is possible.

The machine, the latest development in colorimetry, the science of measuring color, will determine the ability of the human observer to discriminate between different colors, to match color differences between pairs of colors and to establish a color order system represented by colors uniformly spaced.

Preliminary work with the colorimeter indicates that it may not be possible to produce a color chart in which the differences between a selected number of colors are entirely uniform. However, it may be possible to produce sophisticated mathematical formulas to determine such color differences accurately.

Such formulas would enable an industry to select a color for a product and determine exactly the degree to which a color to be used may be off the true color.

Dr. Wyszecki says that color tolerance specifications are as important to industry as the measurement of colors themselves. It would not be economic for industry to attempt to exactly match all colors. A product can still be acceptable if the difference in color falls within a specified tolerance.

For some products, such as bathroom tile, a close tolerance is required. This type of tolerance is not required in choosing a color for a line of plastic toys.

Appointments and Awards

Dr. G. Malcolm Brown, 49, Professor of Medicine at Queen's University, Kingston, Ontario, since 1951, has been appointed Chairman of the Medical Research Council. He assumed office September 1, 1965. A consultant in internal medicine, Dr. Brown succeeded Dr. Ray Farquharson who died in Ottawa early in June following a heart attack.

Dr. W. H. Cook, Director of NRC's Division of Biosciences, has been appointed to the Board of Governors of the University of Guelph at Guelph, Ontario. The University was established in May, 1964.

Dr. R. F. Legget, Director of NRC's Division of Building Research, has been elected President of the American Society for Testing and Materials. He is the second Canadian to hold this office in the 70-year history of the Society; J. G. Morrow of Hamilton was President from 1949 to 1950.

Dr. W. G. Schneider, 49, Director of NRC's Division of Pure Chemistry, was appointed Vice-President (Scientific) of the Council, effective September 23, 1965. Dr. Schneider succeeds Dr. Léo Marion, who recently was appointed Dean of the Faculty of Pure and Applied Science of the University of Ottawa.

New Life For Stored Vegetables

Mr. van den Berg and Mr. Lentz examine carrots stored for nine months.

A series of long-term tests at the National Research Council has produced a new way to extend the storage life of fresh vegetables without appreciable loss of quality or weight.

The tests, conducted by the Food Technology Section of NRC's Division of Biosciences, show that fresh vegetables can be stored for longer periods if they are kept at a uniformly low temperature under maximum humidity conditions.

The system employs a jacketed type of storage room construction. Cooling air is circulated through a jacket or space between two walls rather than through the storage area itself.

Only heat produced by the vegetables is removed from the storage room by the cooling air. This air does not remove moisture from the vegetables, as in a conventional system where the cooling air circulates within the storage chamber.

Results of the research contradict widespread belief in the trade and among many researchers that high humidity causes excessive decay of fresh vegetables during storage. The tests showed that decay losses are minimal.

Claude Lentz, head of the Food Technology Section, and his associate, Bert van den Berg, say the jacket system promises to:

1. Markedly increase the marketing season of Canadian grown vegetables;
2. Result in larger returns to producers in the fall and winter;
3. Reduce the need for imported fresh vegetables in winter, and consequently have a favorable effect on the Canadian balance of payments situation.

"Wider use of high humidity and low temperature in commercial storage practice is in the interest of the producer, processor and consumer, as well as the national balance of trade," said Mr. van den Berg.

An earlier research program showed that apples and celery lost appreciably less weight and retained a better eating quality during high humidity storage than during storage under commercially recommended humidities.

In these tests, apples and celery were stored at a humidity of between 95 and 100 per cent, with the temperature hovering around 32 degrees Fahrenheit. Humidities now recommended by the trade range from 85 to 95 per cent.

The storage life of fresh celery increased 50 per cent at this high humidity. Apples harvested last September were as crisp and tasty in July as when they were picked.

The tests with apples and celery showed conclusively the beneficial effect of high relative humidity. However, extensive tests with varieties of vegetables were considered necessary to determine whether high humidity also would extend their storage life.

Storage tests now have been completed with four varieties of carrots from three major producing areas in Ontario and Quebec. The tests were made over a period of three storage seasons.

Carrots were selected for study because of their commercial importance and their high susceptibility to moisture loss.

Results showed that carrots can be stored at a temperature of from 32 to 34 degrees Fahrenheit for substantially

longer periods than now is done commercially by maintaining the relative humidity as close to saturation as possible.

At this high humidity decay losses were lower than losses when the humidity was lower (92 to 96 per cent). Specifically, in the jacket system, decay losses for a good storage variety (maleic hydrazide treated special long type Nantes) were 15 per cent after nine months at the high level of humidity as against 25 per cent at the lower humidity. In commercial practice, storage beyond six months usually is limited by excessive decay (50 per cent or greater).

Carrots retain their quality better with less weight loss and without increased decay, or possibly reduced decay, when stored at 98 to 100 per cent humidity than when stored at lower humidities. The temperature must be uniformly maintained close to 32 degrees.

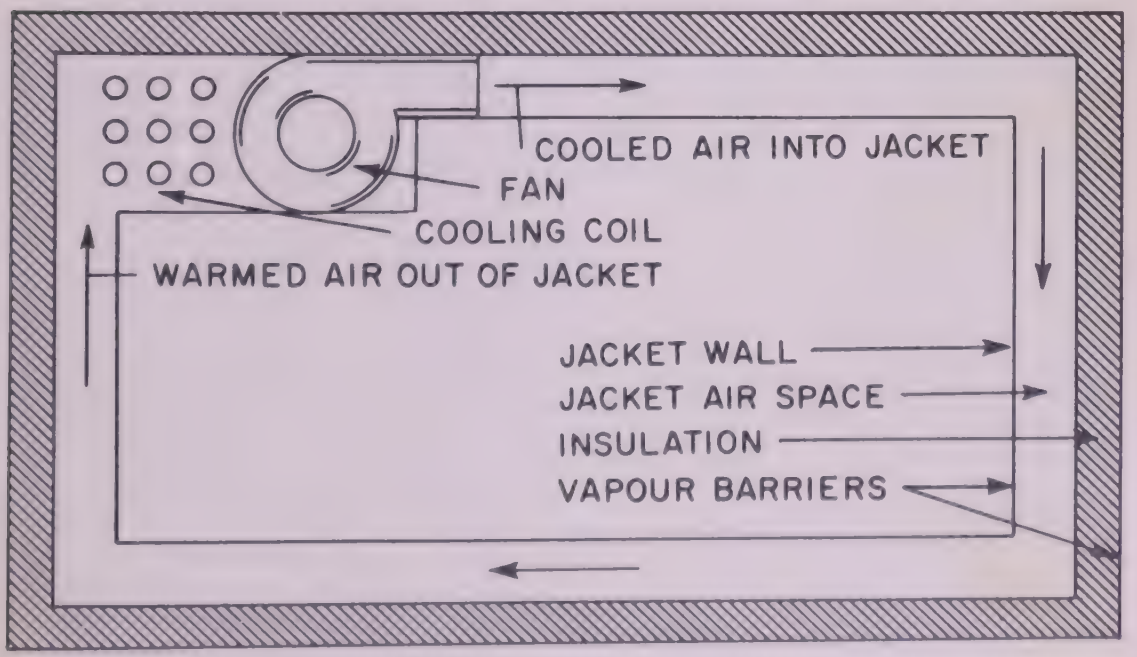
Storage tests also have started with green and red cabbage. Results indicate these vegetables can be stored at a temperature of 32 to 34 degrees Fahrenheit at 98 to 100 per cent relative humidity for about five months with negligible trimming losses. After eight months, trimming losses ranged from 15 to 30 per cent.

The first commercial acceptance of the system came from the Prince Edward County Fruit Growers Co-op at Picton, Ont., in the centre of one of Ontario's largest apple growing districts.

The Picton group built two large storage rooms in accordance with NRC recommendations, with capacities of 12,000 to 15,000 bushels each. After preliminary tests with apples and several years of satisfactory operation, the group built three more larger storage rooms.

"But in spite of their good results the idea has not caught on widely," Mr. Lentz said.

He said the additional cost involved in the construction of jacketed types of storage rooms is not great. Capital expenditures would not be any more than about 15 per cent greater than the cost of building conventional storage chambers.



Schematic drawing of jacketed room illustrating principle used in high humidity storage of fresh vegetables.

NRC at the CNE

Prime Minister Lester B. Pearson visits the NRC exhibit at the Canadian National Exhibition in Toronto Aug. 20 - Sept. 6.

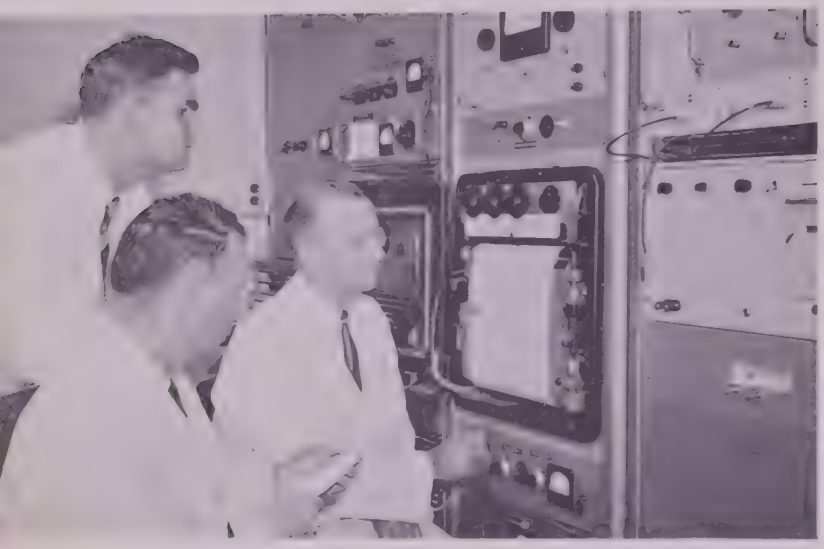
NRC technician C. J. Margerum explains to His Excellency S. P. O. Kumi, Ghanian High Commissioner to Canada, the operation of an NRC-developed antenna used in spacecraft.

NRC at the CNE

The NRC exhibit at the CNE.

Dr. K. M. Baird, head of the Interferometry Section of NRC's Division of Applied Physics, explains the Baird Laser to visitors at the NRC exhibit at the CNE.

New Atomic Clock at NRC



Physicists Dr. Allan Mungall, Herman Daams and Ralph Bailey watching recording equipment for NRC's new atomic clock.

A growing sector of Canadian industry is becoming increasingly dependent for accurate measurement of time and frequency on a new atomic clock built by the National Research Council.

The service provided by this clock makes it possible for firms producing specialized electronic and communications equipment to build to rigid specifications. Equipment of this type must be dead-on to specification to be marketable.

Built by the Electricity Section of NRC's Division of Applied Physics, the clock is known technically as a long-beam cesium resonator. It is used to establish time and frequency to within an accuracy of three parts in one hundred billion, a degree of precision that defies the imagination.

Modern advances in science have made it necessary to measure time intervals of a fraction of a second to a high degree of accuracy. For laboratory work astronomical methods of telling time are too coarse and take too long. Man-made clocks dependent on a mechanical or electro-mechanical property of matter are not stable to the required accuracy, and a means of quickly checking their rate is required. Atomic clocks fill this need and represent the highest precision attained so far.

The new atomic clock at NRC contains the element cesium. The atoms of this element act something like tiny magnets. In an atomic clock these atoms align themselves with magnetic fields and move either in the direction of the field gradient or against it. They also tend to reverse their direction of motion when they are excited at a specific microwave frequency. This behaviour, which occurs at a frequency of 9,192,631,770 cycles a second, is used to define the atomic second.

The clock is an important addition to equipment operated by the Division of Applied Physics to provide industry with accurate fundamental standards for physical measurement. These include mass, length, electricity, heat, light, ionizing radiations, time and frequency.

The Electricity Section uses the atomic clock to check a continuous radio frequency transmitted from Ottawa by the Defence Research Telecommunications Establishment of the Defence Research Board.

This signal, which has a frequency of about 80 kilocycles a second, can be picked up with sensitive receiving equipment by Canadian firms working in electronics and communications. These firms use the frequency as a standard to ensure that the equipment they are manufacturing is operating within a specified range of frequencies.

The DRB signal varies minutely in frequency from day to day and knowledge of this variation is required to enable the firms to calibrate the instruments they

use to check the frequencies of their finished products. The amount of variation, which seldom exceeds a few parts in one hundred billion, is determined by the atomic clock and is provided to industry by NRC in monthly reports.

Dr. J. T. Henderson, head of the Electricity Section, says more Canadian firms should take advantage of this service.

Dr. Allan Mungall, who is in charge of NRC atomic clocks, says highly precise frequency measurements are becoming of increasing importance in many industrial applications. Manufacturers are finding to an increasing degree that their products must meet the rigid specifications required by government organizations in Canada, the United States and other western countries, or they make no sales.

Due to its ability to establish the second with a high degree of accuracy, the atomic clock now is Canada's basic time standard.

It is used daily by the Electricity Section to check variations in the frequency of the quartz-crystal oscillators at NRC and the Dominion Observatory, which are used to control all Canadian time signals.

The frequency of the quartz crystal is used to run an electronic clock, instead of a pendulum clock. This frequency varies but the amount of deviation is determined daily by the cesium resonator or atomic clock. With this information the rate of the crystal clock can be corrected.

Dr. Henderson and Dr. Mungall say atomic clocks of the future will:

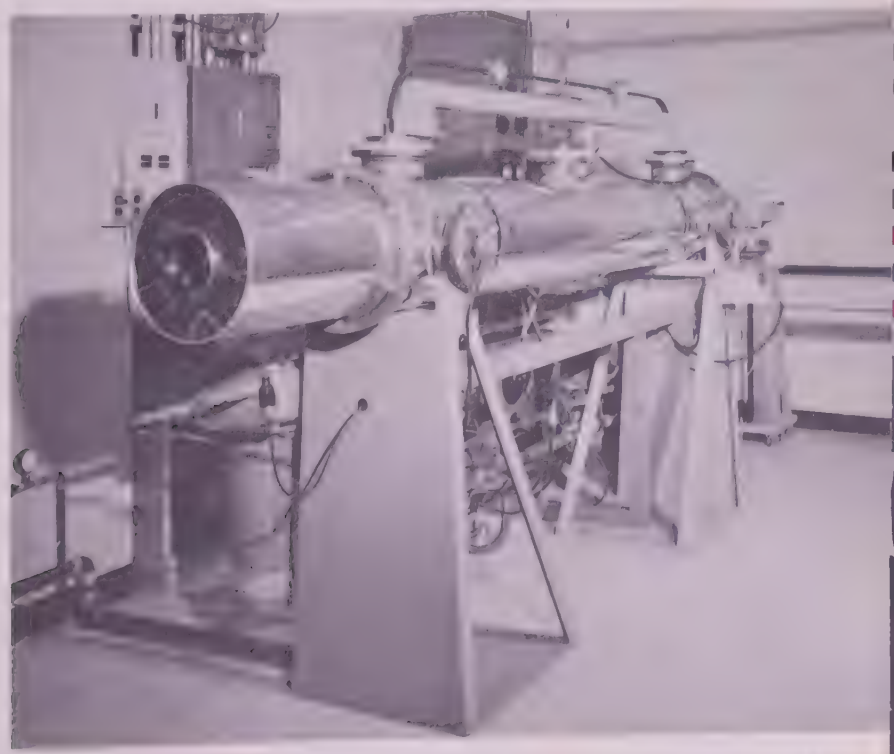
1. Play a major role in fundamental physical research.

2. Provide precise frequencies to make possible communications over vast solar distances.

3. Be essential for interstellar navigation since time so far is the best way to achieve directional control in space.

4. Make possible the simultaneous sending of greater numbers of messages over telegraph lines, as the existing system of dividing signals into precise times (time spacing) is improved.

But even with this kind of accuracy the cesium clock may not be the ideal choice for the definition of an atomic second. Work also is in progress at NRC on the construction of a pair of hydrogen masers. There are indications that, if certain technical problems can be overcome, they may provide a more stable and reproducible atomic frequency standard than does the cesium beam.



NRC's long-beam cesium resonator.

Aerial view of the Dingwall breakwater layout.

All-Tide, All-Weather Harbor

Science has washed away the encroaching sands and brought back economic prosperity to the tiny fishing village of Dingwall, Nova Scotia.

In 1960, Dingwall was fast becoming a ghost town. More than half the population of 500 had left, 65 homes were empty and the local church was about to be closed.

The harbor had been clogged with sand for three years, resulting in almost complete collapse of the local fishing industry, and economic stagnation. At low tide, there was only five feet of water, making the harbor useless for fishing vessels.

Constant dredging could not compete with a heavy movement of sand along the shore and into the harbor.

Today Dingwall has an all-tide, all-weather harbor, a revived fishing industry and a thriving economy.

Those who left to earn a living elsewhere have returned. Last fall the Dingwall Fish Company installed new equipment worth $40,000 to cope with an increased catch. All the vacant homes are occupied and some 20 new houses have been built.

Dingwall escaped becoming a ghost town because model tests by the National Research Council in co-operation with the Federal Department of Public Works indicated that a system of breakwaters would prevent siltation of the harbor.

A series of piers and breakwaters were aligned in such a way that energy created by waves scours sand from the harbor bottom, maintaining an adequate channel depth. The harbor actually is self-dredging.

"If the breakwaters hadn't been built there wouldn't be a village here today", said Peter Walsh, manager of the fish company.

"Absolutely, it would have been a ghost town", said Maurice A. Capstick, spokesman for Dingwall fishermen.

After the Dingwall harbor was forced to close in 1957, the Hydraulics Section of NRC's Mechanical Engineering Division was asked to determine whether anything could be done to keep sand out of the harbor.

An exact model of the harbor was built at the section's Ottawa laboratory and hydraulic model studies were conducted over a three-year period.

After the self-dredging concept had been developed, DPW completed the pier and breakwater construction in 1962 at a cost of about $200,000.

A dam was built to divert the Aspy River from the harbor. In addition a channel 80 feet wide and 900 feet long was dredged in the harbor entrance. The channel was dredged to twelve feet and has since scoured to eighteen feet.

The breakwaters have completely overcome Dingwall harbor's silting problem.

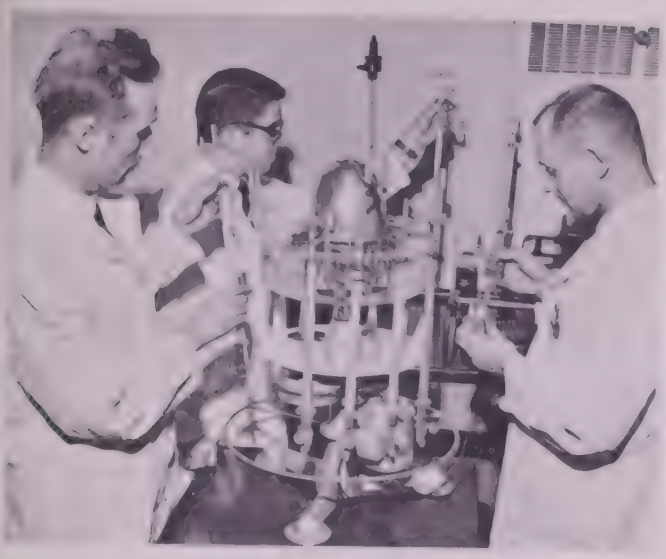
S. D. Vair, secretary-treasurer of the Dingwall Fish Company, said the winter of 1962 produced the worst weather conditions in the memory of Dingwall's oldest residents. Despite these conditions no silting took place and the water was calm inside the newly-protected harbor.

The breakwaters have effectively maintained the desired channel depths from the inner harbor to the open sea. But a high bluff to the south of the harbor entrance began eroding at a rapid rate, depositing sand at the harbor entrance.

To overcome this problem, Public Works last year built four rubble mound groynes perpendicular to the shore to trap this movement of sand. They are each 300 feet long with a crest dimension of 10 feet.

Dingwall is located on the east coast of Cape Breton, 50 miles northwest of Sydney. Its residents say that as a result of the breakwater construction the harbor is by far the best along the 90-mile stretch of Nova Scotia coast line between St. Anns and Cheticamp.

Leader in Dental Research



Dr. C. M. Dowse (left); Dr. H. W. Kaufman, graduate student; and a technician set up a bone experiment in a live tissue incubator.

Since its inception in 1958 the University of Manitoba Dental School has emphasized basic research in oral biology as an integral part of its academic structure. As a consequence, it is now recognized as a leader in this aspect of dental education and research.

Dr. Israel Kleinberg, a member of the NRC Associate Committee on Dental Research, was the first appointee to the basic research unit and is the present director. He graduated from the University of Toronto as a dentist and trained in oral biology and biochemistry at the University of Durham.

One of his areas of research involves the study of the composition and mechanism of formation of dental plaque, the material depositing on the teeth of many persons which, if not removed, can produce severe disease of the gums as well as dental caries. Others are concerned with the metabolism of the oral bacteria associated with these films and the physical chemical properties of the aqueous calcium phosphate system in relation to its role in tooth formation and destruction.

Dr. Charles M. Dowse, a graduate of the Universities of London and Durham who obtained further training at the University of Rochester School of Medicine and Dentistry, was the second scientist to join the unit. A physiologist and biochemist, Dr. Dowse's interests complemented those already established in the section. His present studies are related to bone metabolism and parathyroid hormone.

Dr. E. T. Pritchard, who joined the staff in 1962, was the first Dental Research Associate to be appointed by the NRC Committee on Dental Research. A graduate of the University of Western Ontario, he taught at the University of Alberta for several years and studied at Harvard University before going to Manitoba. His major research areas are salivary gland secretion phenomena and nervous tissue metabolism.

In 1964 Drs. Colin Dawes and I. R. Hamilton joined the staff. Dr. Dawes is a graduate of Manchester and Durham universities and did post-doctoral study at Harvard. His primary research interest is in the physiology of salivary secretion. Dr. Hamilton is a graduate of Toronto and Wisconsin universities and did post-doctoral study at Oxford. His major interest is in the metabolism of oral bacteria.

NRC supplies most of the financial support for research, although grants from private companies and organizations are held by some members of the unit. In addition to providing grants to staff members, NRC has awarded Dental Research Fellowships to several of the graduate students.

The amount of NRC support to the unit has increased over twenty fold in the last six years.

Bird Hazards to Aircraft

Canada's Associate Committee on Bird Hazards to Aircraft has issued a call for greater international co-operation by countries seeking ways to prevent fatal air crashes and damage to jet aircraft from bird strikes.

The Committee, established in 1962 by NRC, says that without a co-ordinated international attack, the problem at best can be tackled only in a piecemeal manner.

Birds are as much a hazard to jet aircraft as shoals and reefs are to shipping. The danger presented by birds can be reduced in the same way that international co-operation over many years has brought about the world-wide charting of shoals, reefs and other shipping hazards.

Reduction of bird populations at or near airports is needed on an international scale. International co-operation also is required to find ways for planes in flight to avoid birds and to design planes that will be nearly birdproof.

The kind of international co-operation needed can best be achieved by the establishment by other countries of committees similar to the Canadian committee.

The Canadian committee brings together all laboratories and agencies in Canada interested in any part of the problem of bird strikes. This has enabled Canada to approach the problem on a national basis, with all interested parties working together.

Various aspects of the problem are discussed fully by the engineer, the biologist, the agriculturist, the physicist and the mathematician. Research equipment is loaned from one group to another reducing heavy expenditures for instrumentation and equipment.

As a result of this co-operative approach Canada already has achieved practical results, especially in the reduction of bird populations around airports where 80 per cent of bird strikes occur.

Agencies in a number of countries are studying the bird hazard problem. But only Canada, West Germany and New Zealand have established committees to study the problem on a national basis.

The Canadian Committee feels that if more countries could be persuaded to establish national committees this could lead to a co-operative effort at the international level. This is the only way to ensure that all interested parties and countries can work co-operatively to solve the problem.

If there were active national committees in a large number of countries, it would be possible for a laboratory in one country to undertake the major part of the research on one project, while those in other countries could devote their efforts to other aspects of the problem.

Data obtained by these individual research programs could be exchanged to the advantage of all countries.

The bird hazard problem is becoming more serious as greater numbers of jet aircraft go into service.

Most air crashes attributed to birds occur after a jet engine has ingested a bird or after a large bird has struck and seriously damaged an aircraft. Bird strikes are also causing an increasing amount of damage to aircraft where the impact is not serious enough to cause a crash.

There have been at least two major crashes of civil airliners due to bird

strikes, one in Boston in 1960 and the other in Baltimore in 1962. The crashes claimed 79 lives.

The Royal Canadian Air Force has lost one jet fighter and perhaps two others as a result of bird ingestion. No lives were lost but the three planes were worth well over $3,000,000.

At least four pilots are known to have been killed in Ireland, the United States, Spain and India when their planes struck birds.

Records on air crashes caused by bird strikes are meagre. However, it is suspected that many unsolved crashes were caused by birds.

Estimates of damage to aircraft also are hard to obtain. But from 1959 to 1963 the RCAF and Air Canada estimate that their damage bill was more than $2,000,000.

Recently, British Overseas Airways Corporation estimated that damage caused by birds had cost it more than 1,000,000 pounds sterling in six years, or about $500,000 a year.

There are a variety of projects which could be studied co-operatively by national committees in various countries. One is the production and analysis of distress calls and the production of high fidelity equipment to reproduce such calls. The effectiveness of using such calls to keep birds away from airports is not fully understood and should be studied on an international basis. It already has been established that distress calls recorded in Holland fail to alarm birds of the same species in England. At the moment, only France and Britain have a co-operative research project in this field.

Another subject is the use of radar to spot large masses of birds, especially during migratory seasons. A series of studies in Canada and in association with Western European radar stations show that an operational system of bird reporting could be established to assist pilots to avoid large flocks of birds.

Work also has started in Canada to learn whether microwave radiation can be effective against birds in flight. Experiments show that microwave radiation in pulsed form has a definite effect on the nervous system of birds.

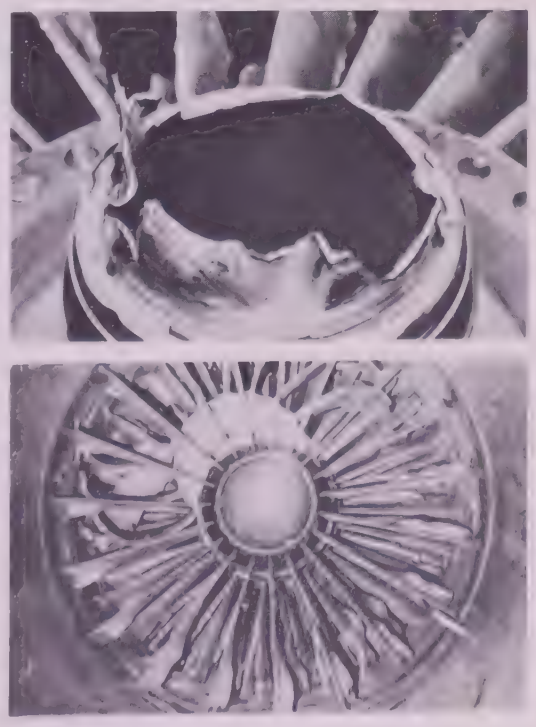
The field of microwave intensity would have to extend at least a mile ahead of a jet aircraft. It would have to be powerful enough to disorient a bird's nervous system to a degree which would cause it to lose altitude quickly.

A jet plane travelling at 600 miles an hour would cover one mile in six seconds. In this period a bird disoriented by microwave radiation would be expected to fall from 300 to 500 feet and be well out of the way of the aircraft.

Experiments to date have produced mixed results. This is a field of research in which greater progress would be made by international co-operation.

A fourth area for international research is in the field of airworthiness. Tests should be conducted to determine what size of bird should be considered as a standard against which aircraft should be designed.

There are other areas requiring effort on an international basis. They include control of bird propagation, development of pyrotechnics and other scaring devices, reporting of bird strikes, use of special ground cover that will not attract birds to airports and the elimination from airport areas of garbage dumps and other bird attractions.



Jet engine damage caused by one or two seagulls (above); a single bird entered the engine shown below, breaking the compressor blades.

Traffic Noise

Traffic noise is like the weather. Everybody talks about it but nobody does anything about it.

Yet din produced by the whine and squeal of tires, the roar of accelerating cars and trucks and the swoosh of fast moving traffic gets worse year by year.

And Dr. George J. Thiessen, head of the Acoustics Section of NRC's Division of Applied Physics, thinks it's time that something was done to produce a little peace and quiet.

"The automobile industry, muffler manufacturers, trucking companies, planning officials, legislators, traffic engineers, highway engineers and acoustic consultants all need to get together for an integrated attack on this increasing menace to the 'good life,'" he says.

Dr. Thiessen doesn't underestimate the magnitude of the economic and political obstacles standing in the way of traffic noise abatement.

In the silencing of a motor vehicle, technology is well ahead of what actually is being done.

Dr. Thiessen suggests that perhaps the main reason nothing is being done is the attitude of the general public, which appears to have a split personality when it comes to traffic noises.

"Unfortunately, the public has a somewhat schizophrenic attitude in this field, which places them in the dilemma of Pooh-Bah in 'The Mikado,'" Dr. Thiessen says.

Most people appear to have a conscious aversion to noise, but they accept it subconsciously as perhaps having prestige value.

"As homeowners, the public would like to enjoy an evening out-of-doors in peace and quiet, but as motorists they want the maximum power to give maximum acceleration even if the tires squeal."

Dr. Thiessen says this probably is the dominant factor behind the reluctance of legislative bodies to apply tighter control on those who produce noise.

"How else can you explain the fact that the most restrictive traffic noise bylaw on this continent allows 75 dBA (decibels on the A scale) at 50 feet from the vehicle, while bylaws restricting industrial noise will specify levels about 20 dB less at industrial residential boundaries?" he asks.

"Relative technological development in the two fields would rule that perhaps the differential should be the other way around. For instance, we know of no way to appreciably reduce the noise of a rock crusher."

NRC research news

JANUARY-FEBRUARY, 1965

6-6-65

Ultrasonic Studies of the Brain — page 7.

Vol. 18, No. 1, Jan-Feb, 1965. Published by the Public Liaison Office, National Research Council, Sussex Drive, Ottawa 2. *Material may be reproduced with or without credit to NRC Research News unless a copyright is specifically indicated.*

Preventing Frost Damage to Roads	3
Western Expands Astronomy	4
Powerful Drop of Water	5
Auroral Rocket Film Takes Off	6
Looking at the Brain with Ultrasonics	7
Steacie Prize Awarded	10
Inventions Booming at C.P. & D.	11
New Associate Committee on Paint	12
NRC Division of Radiation Biology	13
Lever Brothers Launches New Centre	14
Canadian Two-Stage Rocket Fired	15
Fuel Research Improves Safety	15
Talking Turkey at NRC	16

Cover Photo: Model of human skull with exposed brain ventricles. Shift of the midline structures (which vertically separate the right and left hemispheres of the brain) and deformation of the ventricles may be caused by pathological conditions.

Photo credits: Dr. Steacie p. 10 by Malak of Ottawa; Dr. Rosser p. 11 by Paul Horsdal of Ottawa; Dr. Tomecko p. 12, by C-I-L, Montreal; division of radiation biology p. 13 by Atomic Energy of Canada Ltd.; Lever Brothers research centre p. 14 by Feature Four. Ltd., Toronto.

Preventing Frost Damage to Roads

Placing sub-base material over foamed polystyrene insulation at Sudbury, Ontario.

A technique that may be important to Canadian roads and sidewalks is being jointly studied by the National Research Council, Dow Chemical of Canada Limited, and the City of Sudbury. Foamed polystyrene boards are being tested as insulation under 100-foot-long street and sidewalk sections — the purpose to retard frost penetration.

Sudbury is an ideal location for studies because of the frost-susceptible nature of subgrade soils.

Thermocouples have been installed throughout the insulated layer and adjacent sections of street and sidewalk to measure ground temperatures. Swedish-designed frost depth indicators are at key locations for simple measurements of the depth of freezing.

Surface characteristics of the insulated and uninsulated areas will be regularly compared and heaving will be noted.

NRC's division of building research installed the necessary instrumentation in the paving and subgrade. Automatic recording equipment is in the basement of a private house for the main installation on Antwerp Street. There is also a test area on Byng Street.

The pavement structure — 3½ inches of asphalt surfacing, three inches of base course and 18 inches of sub-base — is the standard design normally used on such streets by the City of Sudbury. On the 100-foot insulated section on Byng Street, foamed polystyrene boards two by four feet and two inches thick have been placed at mid-height in the sub-base. At Antwerp Street, the design is the same on half the street while, on the other half, insulation is placed directly on the sub-grade with only nine inches of sub-base material. Insulation slabs were butt-jointed at both locations with no attempt to seal joints between adjacent slabs.

Construction procedure was to fine-grade the area and then secure the insulation slabs in position. Sub-base material was end-dumped and bladed over the insulation making sure a six-inch cushion of material covered the insulation before allowing the bulldozer to pass over the section. With this exception, normal construction practice was used to complete the roadway.

Western Expands Astronomy

Dr. Wehlau

A $5,300,000 extension of astronomy facilities is planned by the University of Western Ontario in London. Half the cost will be supplied by a National Research Council grant, the other half by the University.

A 48-inch reflecting telescope is to be built on a height near Elginfield, 15 miles north of London. The site is convenient to the university campus. Because the city is expected to spread southward, the city lights and industrial growth should represent a minimum problem.

Features planned for the installation, besides the primary 48-inch mirror, probably will include: a coudé focus for high resolution spectroscopy; a cassegrain focus for multicolor photometry and for lower resolution spectroscopy; provision for direct, distortion-free photography of moderately extended objects, such as globular clusters, at the cassegrain focus (this may be accomplished by using Ritchey-Chrétien optics); and off-axis or Nasmyth focus; a drive system designed to move the telescope rapidly from one object to the next.

The new observatory will be part of the university's recently created college of science.

The senior astronomer on the university staff is Dr. William Wehlau who, with his astronomer wife, Dr. Amelia Wehlau, came to the university 10 years ago from the Link Observatory in California and Swasey Observatory in Ohio, as a National Research Council postdoctoral fellow. Later, he was appointed to a full-time position.

The recent rapid growth of astronomy at the university and plans for the new observatory are primarily due to Professor Wehlau.

The university has other staff members interested in astrophysics: Dr. H. van der Laan, from Cambridge; Dr. Peter Manuel, from Western; Dr. R. Mitalas, from Cornell; and Dr. K. Innanen, from Toronto. Plans call for more staff by the time the new telescope is ready for use.

The educational policy of the university has encouraged the growth of astronomy for several decades. It began with Dr. H. R. Kingston's appointment to the staff in 1921 and has continued to grow.

The granting of funds for major installations is relatively new for NRC. The president, Dr. B. G. Ballard, said in the Council's 1963-64 annual report: "In the past, the Council's major support to Canadian universities has been its operating grants to university staff members, and its program of graduate scholarships. With the increasing complexity of science, and the expensive instrumentation that this entails, the Council is now considering the need for major scientific installations in the universities, and is proposing to support a limited number of these across the country."

A force that can erode mountains, build mighty rivers or keep you awake nights when it plinks into the kitchen sink a single drop of water photographed in 1/3000 second by R. E. Rickerd, National Research Council.

"Auroral Rocket" Film Takes Off

Grant Crabtree

When NRC's director-cameraman, Grant Crabtree, headed for Fort Churchill to shoot "Auroral Rocket", his first science film produced entirely for NRC, the airline found Winnipeg, staging point for Churchill, stormbound. It carried Crabtree to Saskatoon, to Regina and back to Winnipeg.

"It seemed a roundabout way of getting to Churchill," says Crabtree.

But from then on the film was "go" all the way. Designed to show Canada's studies of the aurora with Black Brant rockets, it was hammered out by M. W. Thistle, manager of NRC public liaison office, Robert Anderson, consultant, and Crabtree himself.

First shown at the American Association for the Advancement of Science meeting in Montreal, it "seemed to please a lot of scientists all at once, which is saying a great deal," says Thistle.

The film had outstanding NRC advisers, Dr. D. C. Rose, division of pure physics, and W. L. Haney, radio and electrical engineering division.

A potential problem lay in satisfying the large number of co-operating organizations: the USAF, Defence Research Northern Laboratories, Department of Public Works, Pan American Airways, the University of Saskatchewan, the University of Alberta, Canadian Bristol Aerojet Ltd., the Canadian Army Research Development Establishment, the Department of Defence Production, Canadair Ltd. As things turned out, co-operation was excellent, says Crabtree.

The 17-minute color film was recorded by the National Film Board. Animations were by William Mason, of Ottawa, and commentary by an NRC scientist, J. H. Craven, of the radio and electrical engineering division.

For 51-year-old, Ottawa-born Crabtree, the film is among many outstanding successes. He "held the camera" for "The Loon's Necklace", which won 15 awards for NFB and for "Morning on the Lievre", which won 12 awards.

"Auroral Rocket" will be available through the National Science Film Library, sponsored by NRC. The Library, rapidly growing, should shortly be the largest depository of science films in the world.

The nose cone of an auroral rocket . . . it takes two years to prepare to fire . . . six minutes of flight . . . six months to process data received from space.

Diagnosis of brain disorders by ultrasonics is being studied at National Research Council. The technique and apparatus may help detect brain tumors, internal bleeding and the enlargement of ventricles due to the increase of pressure of cerebral fluid.

It could be useful in diagnosing skull-brain injuries as well as providing a fast convenient preliminary screening method and for post-operative examinations.

"It may eventually replace other diagnostic means," say Dr. David Makow and R. R. Real, of the division of applied physics, who are carrying out the work.

However, they emphasize, the apparatus is not ready for commercial production.

At present two X-ray methods are used to show the inside of the brain. In ventriculography the cerebral fluid is replaced by air and the head is then X-rayed. In angiography, the X-ray is made after an opaque substance has been injected into the blood. Both methods are relatively complicated.

Ultrasonics has already been used to outline other internal parts of the body. The ultrasonic waves are directed into the organ being investigated and reflect back according to characteristics of the tissue they encounter. These reflected echo waves can be amplified, reproduced on an oscilloscope screen and photographed.

But the brain presents unique problems. For instance, the skull causes energy loss of the ultrasonic waves, and because of its unequal thickness and composition it distorts the beam.

Nevertheless, it has been shown in the past that single echoes can be obtained from prominent structures in the centre plane of the brain, the midline. These

The display screen showing the positions of the ultrasonic beam as it scans during one revolution.

echoes are displaced in one dimension when brain disorders are present, suggesting that a further extension of this technique is possible which would reveal not only the displacement but also the size and shape of internal structures.

To achieve an improved instrument it will be necessary to obtain echoes from sites around the head in such a way that results can be correlated to obtain a two-dimensional picture.

Work is under way in several countries although, in most, the effort is to obtain a partial rather than a complete cross-section of the head. At NRC a method of obtaining a complete cross-section is being sought.

The equipment now being developed consists of a rotating water-filled tub, a

The system in operation. . . . The rotating water tank moves the scanning transducer around the head. It takes one minute for the complete cross-sectional image to appear on the display screen in the background.

scanning transducer which converts electrical energy into an ultrasonic beam, a transmitter-receiver and a display screen system.

The patient lies on his back on a stretcher above the tub, his head bent downward and immersed in the water to the level of ears and eyes. The water provides a more efficient means of carrying the ultrasonic waves than air.

The transducer is placed just beneath the water surface near the wall of the tank. High voltage pulses from the transmitter are applied across this transducer, causing it to emit ultrasonic pulses at a carrier frequency of two million cycles a second. The pulses are beamed through the water at the head, and the tub with transducer is rotated around the head while the transducer scans back and forth.

Some of the energy penetrates the skull and is reflected back from interfaces between dissimilar brain tissues. The echoes are received by the transducer and amplified in the receiver. The electronic display system marks these echoes on a screen in positions that correspond to the location of the reflecting tissues in the head. After one tank revolution has been completed, the superposition of the echoes forms a cross-sectional image of structures inside the head. This can be photographed by a camera above the screen.

So far, it has been possible to receive reliable reflections only from tissues in the brain which lie in the midline plane separating the two brain hemispheres.

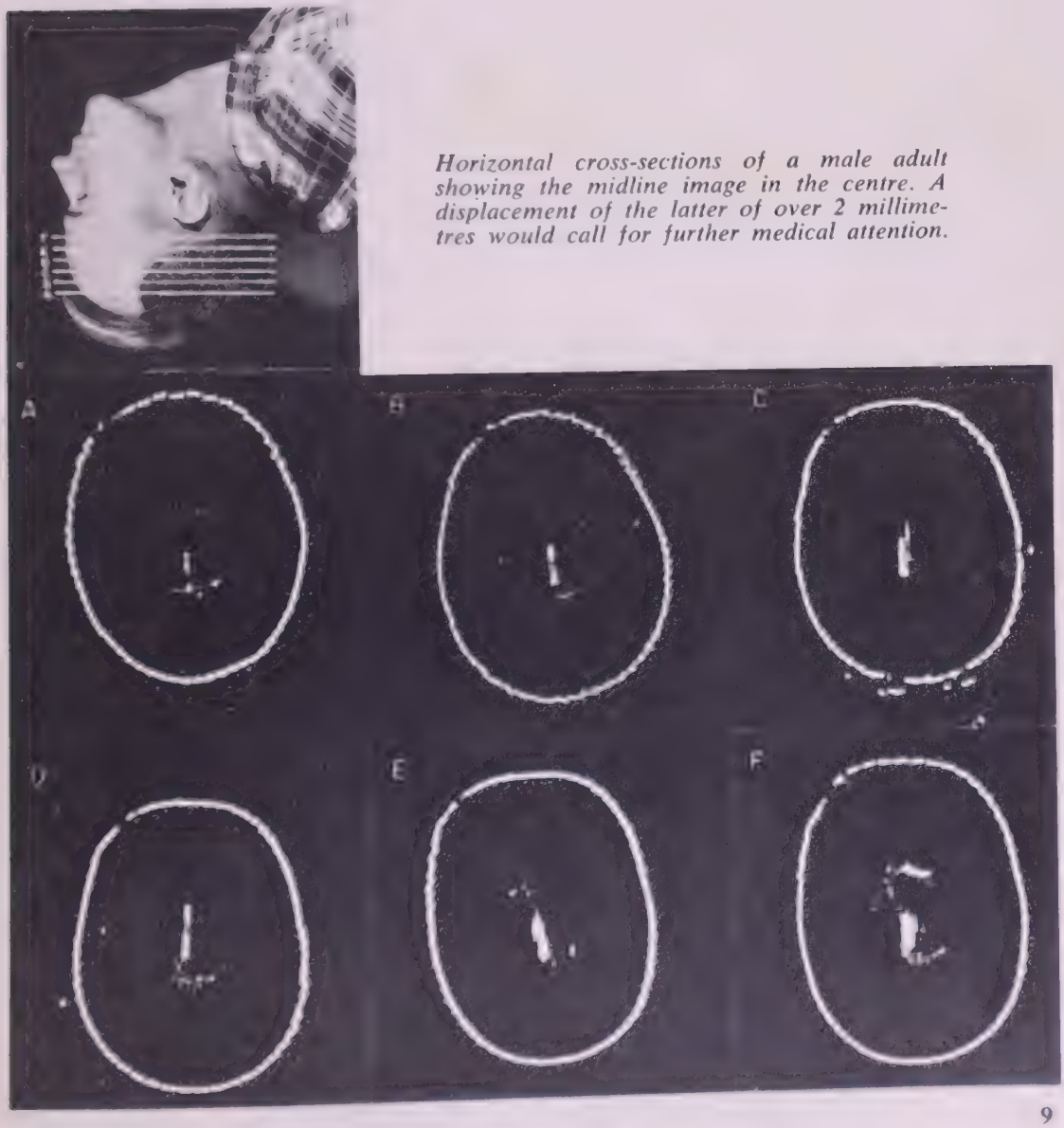
These midline echoes are the most prominent because they come from tissues that reflect readily and because the ultrasonic beam is approximately at right angles to them when it passes through the region of the temple, the thinnest part of the skull.

The work, which is continuing, provides a challenge both to the physicist and the electronic engineer, say Dr. Makow and Mr. Real.

A problem is the limited resolving power of the beam at the frequencies for which development of the system seems possible. Also, meaningless echoes caused by multiple reflections and reverberation are received from inside the head.

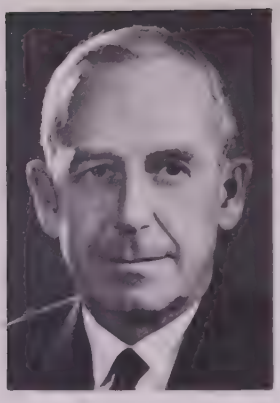
In the NRC equipment the gain (volume) control of the receiver is actuated by the first strong echo from the skull, permitting a skull-locked gain characteristic for echoes coming from inside the head. This strong echo also generates a new pulse which is used to outline the skull. A choice of modified or original echoes, or the sum of both, is available for reproducing the image of the interior of the head on the screen.

The pressure of the cerebral fluid varies at the same frequency as the heart beat and echoes received from structures filled with cerebral fluid pulsate at that frequency. Circuits have been developed that determine whether echoes received pulsate, thus permitting identification of pulsating and non-pulsating structures in the brain.



Horizontal cross-sections of a male adult showing the midline image in the centre. A displacement of the latter of over 2 millimetres would call for further medical attention.

Steacie Prize Awarded To U. of T. Professor



Dr. Steacie

The E. W. R. Steacie Prize in the Natural Sciences, amounting to $1,000, has been awarded for the first time. The recipient, chosen by trustees drawn from the universities, industry and the National Research Council, is Professor Jan van Kranendonk, professor of physics at the University of Toronto.

In 16 years of active research, Dr. Van Kranendonk has made many contributions in the application of quantum and statistical mechanics to molecular and solid state physics. He has published about 40 important scientific papers in the field.

Prof. Van Kranendonk

Born in Delft, in The Netherlands, Dr. Van Kranendonk has held posts in the University of Amsterdam, Harvard University, Leiden University, and joined the staff of the University of Toronto in 1958.

Dr. Steacie, in whose memory the prize is given, was president of NRC from 1952-1962. In recognition of Dr. Steacie's encouragement of younger scientists, the award will not usually be made to scientists over the age of 40.

The award was made to Dr. Van Kranendonk at a dinner given by Dr. Claude Bissell, the president of the University of Toronto. Mrs. Steacie was among those who attended.

Trustees of E. W. R. Steacie Memorial Fund

Dr.. P. R. Gendron, president, Dow Brewery Ltd., Montreal, Que.

Dr. P. A. Giguère, directeur, département de chimie, faculté des sciences, Université Laval, Québec.

Dr. H. E. Gunning, professor and head of the department of chemistry, University of Alberta, Edmonton, Alta.

Dr. D. J. Leroy, head of the department of chemistry, University of Toronto, Toronto, Ont.

Dr. F. P. Lossing, head, mass spectrometry section, division of pure chemistry, NRC, Ottawa, Ont.

Dr. C. J. Mackenzie, former president of NRC, Ottawa, Ont.

Dr. J. A. Morrison, head, surface chemistry and low temperature calorimetry section, division of pure chemistry, NRC, Ottawa, Ont.

Dr. W. G. Schneider, director, division of pure chemistry, NRC, Ottawa, Ont.

Dr. H. G. Thode, president and vice-chancellor, McMaster University, Hamilton, Ont.

Miss K. Densmore, administrative assistant, division of pure chemistry, NRC, Ottawa, Ont.

Inventions Booming At C.P. and D.

Dr. Rosser

The steady introduction of Canadian inventions to Canadian industry is continuing, reveals the annual report of Canadian Patents and Development Limited, issued recently.

C.P. and D. is responsible for patenting, licensing and some of the development of inventions and processes from the National Research Council and government departments, Atomic Energy of Canada Limited, and certain universities. It does not receive inventions for processing from the public or from industry.

Operated as a subsidiary of NRC, the company last year received 132 new inventions or processes for assessment. It took in $379,680 in royalties, dispersed $15,000 to inventors and $30,556 as share of royalties to other organizations.

It filed 50 new patent applications and supervised the filing by agents of 72 patent applications. The company negotiated the terms of 19 licensing agreements and nine development contracts.

Dr. F. T. Rosser, vice-president (administration) of NRC and president of C.P. and D. said in the annual report that "the policy of the company is to get its inventions into production as quickly as possible by a Canadian industry.

"In many cases costly problems are encountered in the scaling up process from laboratory to production line. Recently, the company has been able to offer some financial assistance to industry for such development work. This year approximately $100,000 was spent for this purpose."

C.P. and D. was set up in 1947 to control, develop and exploit inventions arising from the work of NRC. It was intended to bridge the gap between laboratory research and the practical application of its results. Later, its purpose was broadened to serve other organizations as well as NRC, though it still remains a subsidiary of the Council.

"The company is stable, its royalty income now broadly based on 130 licensing agreements," said the annual report. The purpose of the company, it said, is "to provide new inventions with an entrée into Canadian commercial life.

"Thus the true measure of the company's success is not royalty income, but the total amount of internal and export trade generated in Canada."

On the other hand, it was noted, "patents are wasting assets; they do not keep. If no Canadian industry is in a position to exploit an invention, the company considers it better to earn royalties from a foreign manufacturer than to watch the invention become obsolete."

New Associate Committee on Paint Research

Dr. Tomecko

Paint, one of the most widely used of all building materials, presents many technical questions, especially to organizations like the Canadian Government Specifications Board. The Board has more than 100 specifications relating to paint.

To assist the study of paint and other chemical coatings, NRC has set up a new associate committee on paint research, its first chairman Dr. J. W. Tomecko, educational relations manager of Canadian Industries Limited, Montreal.

Dr. Tomecko, born at Lipton, Saskatchewan, studied at the University of Saskatchewan, and McGill.

He joined C-I-L in 1940, as a research chemist, later holding posts in the paint development laboratory, Toronto, and the paints and coated fabrics department, Montreal.

He became educational relations manager in 1958, when he was also assistant general manager of the paints division. As educational relations manager he is responsible for the company's relationships with universities and for its postgraduate fellowship program.

The new associate committee came about following a meeting on paint research sponsored by NRC's division of building research, attended by industry and government people. A joint submission to the Council urging the associate committee's establishment was made by the Canadian Paint Varnish and Lacquer Association and the division of building research.

The committee's purpose is to stimulate and correlate research throughout Canada in all fields of chemical coatings, particularly paints. Membership is drawn from the paint industry, government research laboratories and the universities.

The committee secretary is Dr. R. S. Yamasaki, of NRC's division of building research. There are two corresponding members, Dr. L. Valentine, director of the British Joint Paint Research Laboratory and Dr. H. R. Myers, director of the United States Paint Research Institute.

Symposia in specialized fields will be sponsored to ensure the best possible development of communication and exchange of information.

NRC now has 40 associate committees operating as co-ordinating mechanisms in Canadian science. Each acts as an autonomous unit, the committees drawing members, who serve without salary, from federal, provincial, university, and industrial organizations. Each committee has defined objectives. When these are accomplished, the committee is disbanded, with thanks.

NRC Division of Radiation Biology Makes Progress

Left to right: Dr. G. C. Butler, organizer of the new division, Dr. K. R. Lynn and Miss Gail Mattinson working on radiation biology problems.

The effect of radiation on living things, including people, will be the subject of research in the newest NRC division, now being organized.

It will be the Council's twelfth division, the last to be organized having been the National Aeronautical Establishment in 1959.

Plans call for a new building to be erected on the south side of the Montreal Road in Ottawa, on part of the 340 acres of Council land there. The area is fast becoming the national science centre, already housing most of the major applied divisions of the Council.

The new division is being organized by Dr. Gordon Butler, the director of the biology and health physics division at Atomic Energy of Canada Limited, Chalk River.

"More knowledge of the complex field of the effect of radiation, especially ionizing radiation, on living things is urgently needed," said Dr. Butler. "Man is exposed to increasing amounts of radiation in his environment."

A variety of types of radiation will be used in studies, including ultra-violet light, gamma rays, X-rays, electrons and fast neutrons. Scientists and post-doctorate fellows representing biophysics, biochemistry, physiology, cytology and genetics will be brought on staff. The physical, chemical, functional and statistical changes brought about by irradiation of pure chemicals, biochemicals (enzymes and macromolecules) cells, tissues, micro-organisms, plants, animals and human or animal populations will be investigated.

The scientists plan to study radiations arising within biological materials as well as those originating outside.

Where possible, observations will be made of the effects of radiations delivered at widely differing dose rates.

The opening of the new division will not result in any reduction in work at Chalk River, said Dr. Butler. Instead, the NRC laboratory will expand the Canadian work.

NRC has already supported research in the field by providing funds for associates in radiation biology in seven Canadian universities.

Recruiting of scientific staff for the new division has begun. Three permanent staff members and three post-doctorate fellows are on staff, though they are working out of Chalk River, pending completion of the NRC building. Additional permanent employees are expected to report for duty the middle of this year. Some may occupy space at first in the Sussex Drive building of the Council.

Funds have been allocated for the new building for the division and it is in the planning and design stage, expected to be ready for occupancy in 1967.

Lever Brothers Launches Research Centre

Salaries for three teams of scientific personnel for three years will be paid through National Research Council industrial grants, and they will work in the new $1,500,000 Lever Brothers Limited technical centre in Toronto.

The company will provide a like amount to pay for their direction, facilities and special equipment. These scientists will work in three specific areas, said J. C. Lockwood, president of the company. He did not divulge the exact nature of the research.

The Centre as a whole will develop and evaluate all types of company products, including margarine, powdered and liquid detergents, toothpaste and floor polishes.

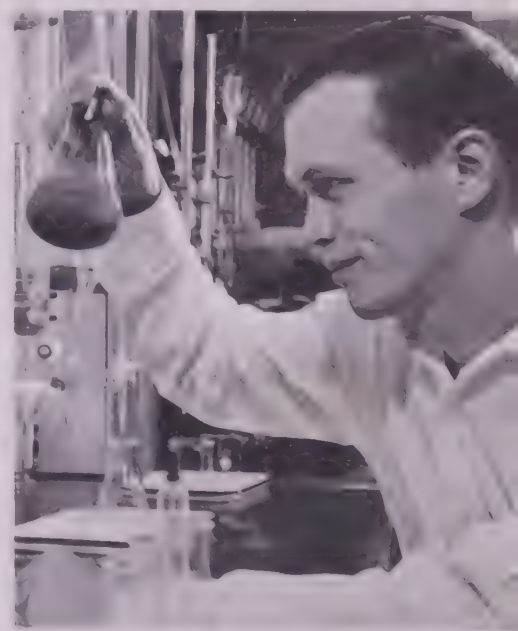
Special equipment in it will include a high-power electron microscope, an artificial mouth capable of duplicating the movement of saliva in the mouth, gas chromatography equipment and miniature plant equipment for simulating conditions in large production vats.

"This type of government aid is what industry needs if it is to prosper and solidly bolster the economy of the country," said Mr. Lockwood. "We must become the leaders in the world, the innovators. This is the way to a strong, vibrant Canada."

The new centre will occupy 35,000 square feet of floor space and has been constructed to permit later construction of two additional floors. This would represent a 50% expansion of research and may be needed in the near future, Mr. Lockwood said.

The NRC industrial grant program is now supporting 112 research projects in 73 industries in Canada.

R. W. Nichols, of Lever Brothers, prepa a sample of edible oils for checking by fra-red spectrophotometer.



Russel Price titrates samples for iodine v ues in a control laboratory at Lever Bro ers' new Technical Centre.

Lever Brothers Ltd. new Technical Centre in Toronto has 35,000 square feet of floor space, and is planned for addition of two more floors. In the laboratories are an artificial mouth, for oral hygiene studies, and an electron microscope, capable of magnification up to 150,000 times, for study of textile structure after washing, and the oral hygiene studies.

Canadian Two-Stage Rocket Fired at Churchill

The first successful two-stage rocket ever made in Canada has been fired at Fort Churchill by Canadian Bristol Aerojet Ltd.

New radio transmitting equipment developed by NRC's radio and electrical engineering division formed part of the 100-pound research payload.

Signals from the one-watt transmitter, which has less power than a flash-light battery, travelled more than 1,200 miles from a point in space 450 miles above Churchill to telemetry recording equipment at NRC in Ottawa. Previous Black Brant rockets fired from the Fort Churchill rocket range were one-stage rockets, which reached a maximum altitude of some 130 miles.

"The main reasons for upper atmosphere research in Canada and probably the more significant are the study of energy emissions from the sun, the nature and composition of the upper atmosphere and the nature and origin of cosmic rays," said W. L. Haney, head of NRC's space electronics section.

Fuel Research Improves Safety

A jet fuel additive developed at Shell Oil Company's Amsterdam laboratories and jointly researched in Canada by the National Research Council, Shell Canada Ltd., and the Royal Canadian Air Force will improve airplane fuelling safety. When fuel is pumped through pipes and filters electrostatic charges may be acquired, possibly resulting in sparks, explosions and fires. NRC investigation showed refuelling to be even more hazardous at low temperatures. The new additive, ASA-3, eliminates the hazards of electrostatic charges during fuelling. A static dissipating additive has now been adopted in the Canadian Government Specifications Board aviation fuel specifications. NRC results were reported at an International Air Transport Association (IATA) Fuel Study Group in Paris. The IATA has included use of this additive in their guidance specifications for aviation turbine fuels.

Talking Turkey at NRC

Dr. D. S. Clark takes a bacteriological sample of a turkey.

NRC has been carrying out research to improve the keeping qualities of poultry and co-operating with the Canada department of agriculture to bring the most modern technical knowledge to every processing plant.

All major Canadian poultry processing plants are now using the immersion freezing system developed largely in NRC's food technology group, led by C. P. Lentz, with help of L. van den Berg.

They are also using research information from the group — such as the 10-20% of moisture absorbed during cooling in ice-water (used almost universally) and subsequent loss of about half of this extra moisture during draining and handling. The group's work on tenderizing (ageing) has been widely recognized and is the basis of recommendations of the Canada department of agriculture.

An objective method was needed to assess the effect of storage time and temperature on quality. Dr. A. W. Khan, another member of the food technology group, found a relation between quality and the ratio of sulphydryl group content and amount of proteolytic breakdown products. In fresh meat this ratio ranges from about 1.5 to 2.0 and durin storage may fall as low as 0.2. Belo 1.0, even the less sensitive taste-pan method of assessment can detect loss quality.

Most of the work was done usin aseptic techniques and hence has ind cated enzymatic and other biochemica changes, rather than microbiologica effects. At temperatures above freezin microbiological changes are at lea equally important. Recent work concer ed with microbiological aspects of pou try processing and storage has bee undertaken by Dr. D. S. Clark.

Methods of maintaining lower an more uniform temperatures for froze poultry (and other frozen foods) durin transportation have also been studie and the jacket air circulation system h been developed for refrigerated truck This work has been done in co-operatio with the poultry-processing and truck manufacturing industries, the C.I.R. th department of fisheries and the depart ment of agriculture.

With the strong support of E. D. Bon nyman of the department of agriculture NRC has provided technical speakers a poultry conferences throughout Canada